

Cantel Mobitex-

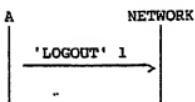
No.	52/1056	- A 296	5171/2 Ue
Date	1990-02-23	1 Rev	To File

14 LOGOUT

The A-party generates 'LOGOUT' according to the criteria and with the structure stated in Appendix A.

Dialogue 14.1:

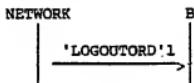
Subscription initiates log-out.

Dialogue 14.2:

Network initiates logout.

The subscription has sent a LOGINREQ from a terminal but is still registered as logged-in to another terminal. The network will then send LOGOUTORD to the old terminal according to the criteria and with the format stated in Appendix A.

The personal subscription should immediately be deleted from the B-party's flexlist.



If the network has sent a LOGOUTORD and the old terminal did not receive it, the LOGOUTORD is repeated when the subscriber sends a message next time.

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Cantel Mobitex

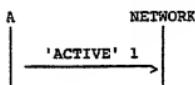
Ref No	52/1056 - A 296 5171/2 Ue
Date Due	1990-02-23 A
F: P MTS09B.2	

15 ACTIVATION

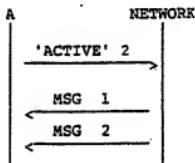
The A-party generates 'ACTIVE' according to the criteria and with the format stated in Appendix A.

Dialogue 15.1:

Activation is approved and the mailbox is empty.

**Dialogue 15.2:**

Activation is approved and there are packets in the mailbox, both for the terminal and the personal subscription.



MSG 1 and 2 are packets (MPAK) that has been stored in the network mailbox while the terminal has been inactive. Each packet sent out from the mailbox is delayed a certain time in order not to overload the terminal.

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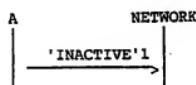
No.	52/1056	A	296	5171/2 Ue
Datum	1990-02-23	Stz	A	F. F.c MTS09B.2

16 INACTIVATION

The A party generates 'INACTIVE' according to the criteria and with the format stated in Appendix A.

Dialogue 16.1:

Inactivation.



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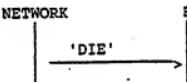
17 DIE - LIVE

The network generates 'DIE' and 'LIVE' according to the criteria and with the format stated in Appendix A.

when the terminal receives 'DIE' it is not allowed to send any user traffic to the network, until a 'LIVE' has been received. User traffic is defined as packets included in the packet classes; PSUBCOM, PSOSCOM and CSUBCOM. The terminal may send DTESERV packets.

Dialogue 17.1:

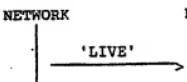
The terminal may not send user traffic.



'DIE' is stored in the network mailbox if the B-party is not active. The packet is sent out according to Dialogue 15.2 when the B party is active again.

Dialogue 17.2 :

The terminal may send packets again.



'LIVE' is stored in the network mailbox if the B-party is not active. The packet is sent out according to dialogue 15.2 when the B-party is active again.

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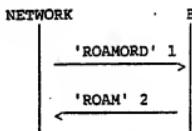
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Given Date 1990-02-23	1 Rev	To File	MTS09B.2

18 ROAMING

Dialogue 18.1:

The network requests the terminal to send a ROAM packet.

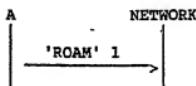
The network generates 'ROAMORD' according to the criteria and with the format stated in Appendix A.



The B-party generates 'ROAM' 2 according to the criteria and with the format stated in Appendix A.

Dialogue 18.2:

The A-party generates 'ROAM' spontaneously according to the criteria and with the format stated in Appendix A. A spontaneous generation of a ROAM packet is initiated from the roaming procedure described in the mobile terminal data link layer.



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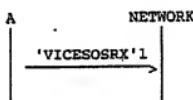
19 RE-DIRECTION OF EMERGENCY MESSAGES

This is used when the emergency messages should be sent to the alternative emergency receiver.

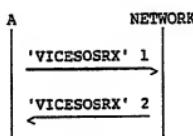
The A party generates 'VICESOSRX' according to the criteria and with the format stated in Appendix A.

Dialogue 19.1:

The re-direction is approved.

**Dialogue 19.2:**

The 'VICESOSRX' is returned from the network.



- a) Re-direction cannot/may not take place.
'VICESOSRX' 2 is returned with traffic state = ILLEGAL
- b) The network is overloaded.
'VICESOSRX' 2 is returned with traffic state = CONGEST
- c) A technical fault may have occurred.
'VICESOSRX' 2 is returned with traffic state = ERROR

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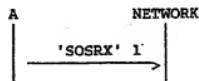
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20 CANCEL RE-DIRECTION OF EMERGENCY MESSAGES

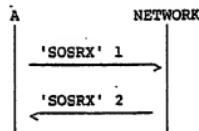
Dialogue 20.1:

The re-direction is cancelled.



Dialogue 20.2:

The cancellation of the re-direction cannot/may not be accepted.



'SOSRX' 2 is returned with traffic state = ILLEGAL

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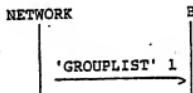
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21 UPDATING GROUPLIST

Dialogue 21.1:

The network generates 'GROUPLIST' according to the criteria and with the format stated in Appendix A.



'GROUPLIST' is stored in the network mailbox if the B party is not active. The packets are sent out according to dialogue 15.2 when the B party is active again.

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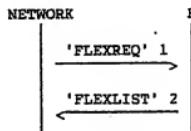
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Issue Date	1990-02-23	I Rev A	Fd Fax MTS09B.2

22 UPDATING THE LIST OF PERSONAL SUBSCRIPTIONS

Dialogue 22.1:

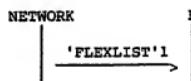
The network generates 'FLEXREQ' according to the criteria and with the format stated in Appendix A.



'FLEXLIST' is generated according to the criteria and with the format stated in Appendix A.

Dialogue 22.2:

The network generates 'FLEXLIST' according to the criteria and with the format stated in Appendix A.



'FLEXLIST' is stored in mailbox if the B party is not active. The packet is sent out according to dialogue 15.2 when the B party is active again.

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Response

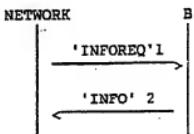
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2.3 TECHNICAL INFORMATION

Dialogue 23.1:

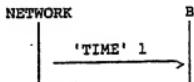
The network generates 'INFOREQ' according to the criteria and with the format stated in Appendix A.



24 TIME INFORMATION

Dialogue 24.1:

The network generates 'TIME' according to the criteria and with the format stated in Appendix A.



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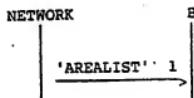
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25 UPDATING AREALIST

Dialogue 25.1:

The network generates 'AREALIST' according to the criteria and with the format stated in Appendix A.

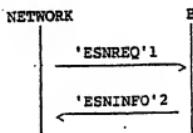


'AREALIST' is stored in the network mailbox if the B party is not active. The packets are sent out according to dialogue 15.2 When the B party is active again.

26 ELECTRONIC SERIAL NUMBER CHECK

Dialogue 26.1:

The network generates 'ESNREQ' according to the criteria and with the format stated in Appendix A.



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REQUIREMENT SPECIFICATION

3.30.2012
1(37)

Fachbericht ET/SYS PES		Reaktionen der Systeme ET/SYS PES	REQUIREMENT SPECIFICATION I (S7)		
Dokument-Nr.: 00000000000000000000000000000000			Nr. S/N: 53/1056-A 296 5171/2 Ue		
Dokument-Nummer: ET/SYS STT STT			Datum: 23.02.1990	Rev.: A	F. d.a.: MTS09C.2
Bemerkung:		Title: MOBITEX Network layer for terminals Appendix C. Logical description			
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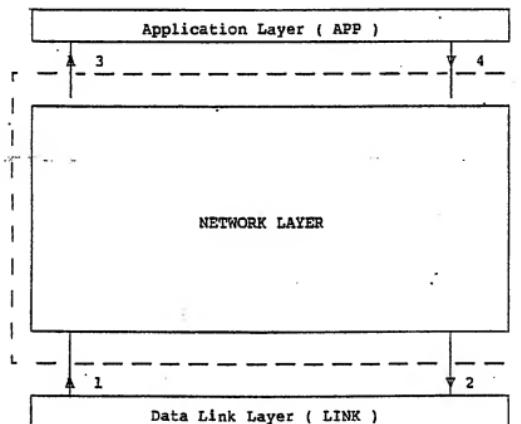
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Date	1990-02-23	Rev.	A
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1 GENERAL

1.1 DATA FLOW DIAGRAM

The data flow diagram below shows the interaction between the network layer and the other two layers; the data link layer and the application layer.



Signals to/from Data Link Layer.

- 1- MPAK_transmitted, MPAK_not_transmitted, MPAK_received, roaming, activation
- 2- MPAK_to_transmit, MPAK_to_retransmit, speech_on, speech_off, order_to_return_MPAK, group_list_information, area_list_information

Signals to/from Application Layer.

- 3- MPAK_received, returned_MPAK_with_code, die, live, buffer_full
- 4- MPAK_to_transmit, hook_on, hook_off, power_off, manual_mode_on, MPAK_to_retransmit

Bottom

Repos

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Datum	Jahr	Ue
1990-02-23 A MTS09C.2		
1.2 TERMINOLOGY		
P_ / F_	In this logical description, all procedures starts with "P_", and all functions with "F_".	
input_signal	The network layer has an input queue. A signal from this input queue is called "input_signal".	
wait_for_input_signal	The network layer is waiting until un input_signal is available.	
save_signal	Restoring the signal into the queue. This is done when you expect a certain signal. By repeating input signal and save_signal, you can search in the input queue for certain signals. All saved signals are available when an input_signal follows after an input_signal without any save_signal between. See chapter 'Queue handling'.	
ignore_signal	No further handling of this signal, except that the signal should be deleted.	
grouplist	Area where group MAN are stored. This list should be stored also during power off.	
flexlist	Area where personal subscription MAN are stored. This list should be stored also during power off.	
permanent_list	Total area to be continuously stored. In this area terminal MAN, serial number, group list, flexlist, die_state and live_state are stored. The checksum is calculated based on this list.	
grouplist_received_flag	Indication of a correct permanent list and that a MPAK:GROUPLIST is received or not.	
active_delay_power_up	Activation delay concerning power-up and manual radio mode. See R1-06.	
active_delay_lost_contact	Activation delay concerning lost contact. See R1-06.	
power_off_ready	Flag to indicate that the network layer is ready to be closed.	
Stukort		
Replies		

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manual_mode	Flag to indicate that the mobile station is in manual mode.		
buffer_full_flag	Indication of buffer full.		
emergency_flag	Indication of an activated emergency. When application layer receive an emergency signal, this flag is raised. Now the network layer can handle the priority of emergency in the terminal.		

Edition

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Cantel Mobitex

Sp. No.	53/1056-A 296	5171/2 Ue
Issue Date	1 Rev. 1990-02-23	F.C. F.S. MTS09C.2

1.2 SIGNALS

MPAK_to_transmit	MPAK received from the application layer or MPAK to the data link layer to be transmitted.
MPAK_received	MPAK received by the data link layer or MPAK to be sent to the application layer.
MPAK_transmitted	MPAK successfully transmitted by the data link layer.
MPAK_not_transmitted	MPAK not transmitted by the data link layer.
MPAK_to_retransmit	MPAK from the application layer to the data link layer to be retransmitted (special treatment in the data link layer).
roaming	Order to the network layer to send an MPAK:ROAM.
activation	Start activation timeout (after power-on or lost contact with base) given in R1-06.
speech_on	Order to the data link layer to set mode speech_on.
speech_off	Order to the data link layer to set mode speech_off.
order_to_return_MPak	Order to the data link layer to stop sending an MPAK, and return the MPAK to the network layer.
group_list_information	Group list information to the data link layer.
area_list_information	Area list information to the data link layer.
returned_MPak_with_code	Returned MPAK with code information from the network layer. The code shows why the MPAK was returned.

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hook_on		Hook_on signal from the application layer.
hook_off		Hook_off signal from the application layer.
die		A signal informing that the network layer has received an MPAK:DIE. All user traffic is stopped and returned to the application layer.
live		A signal informing that the network layer has received an MPAK:LIVE. User traffic from the application layer can be handled.
buffer_full		Queue for incoming messages is full. Incoming and outgoing traffic from/to the MOBITEX network is stopped. The network layer tries to send MPAK:INACTIVE. Application layer is informed. When the message buffer has space for at least 6 messages, according to specification RI-09, the buffer_full_flag is reset and incoming and outgoing traffic is resumed.
power_off		The application layer wants to turn the network layer off. The network layer tries to send an MPAK:INACTIVE.
power_off_timeout		Internal timeout to indicate that the network layer is ready to be turned off.
manual_mode_on		The application layer wants to turn over to manual radio mode. The network layer tries to send an MPAK:INACTIVE.
manual_mode_on_timeout		Internal timeout to indicate that the network layer is ready to turn over to manual radio mode.

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1.3 RETURNED MPAK WITH CODE		
<u>CODE</u>		<u>MEANING</u>
SENT		This MPAK has been correctly sent by the data link layer.
NOT_SENT		This MPAK has not been correctly sent by the data link layer.
NOT_SENT_SPEECH		This MPAK has not been sent because of speech state in the network layer.
NOT_SENT_DIE		This MPAK has not been sent because of die state in the network layer.
NOT_SENT_BUFFER_FULL		This MPAK has not been sent because of buffer_full state in the network layer.
INCORRECT		Received MPAK from the application layer, do not have a correct format or is not allowed to be sent.
PERSONAL_MAN_EXIST		Present personal subscription MAN already exist in the flexlist.
PERSONAL_MAN_NOT_EXIST		Present personal subscription MAN does not exist in the flexlist.
FLEXLIST_FULL		The maximum number of MAN in the flexlist is exceeded.
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1.4 STATES

idle	Idle state
die_state	'A received MPAK:DIE has ordered the mobile to this state. No outgoing user traffic is allowed. A received MPAK:LIVE orders the mobile to idle state.'
sending_during_die	Only MPAK of class DTESERV and MPAK:DISCON (CSUBCOM) can be sent during die_state.
link_busy	The data link layer can only handle one packet at a time. In the present state, the data link layer is busy.
sending_conreq	The data link layer is busy sending speech request.
stop_sending	The network layer has ordered the data link layer to stop sending present packet. The network layer is waiting until the data link layer is ready.
wait_for_hook_off_normal	A normal speech request is received and the network layer is waiting for response from the application layer.
wait_for_hook_off_fast	A fast speech request is received and the network layer is waiting for response from the application layer.
wait_for_hook_off_group	A group speech request is received and the network layer is waiting for response from the application layer.
sending_conrea	The data link layer is busy sending a hook_off signal (MPAK:CONREA).
speech_normal	The network layer is in speech state.
speech_group	The network layer is in group speech state.
sending_discon	The data link layer is busy sending a hook_on signal(MPAK:DISCON).

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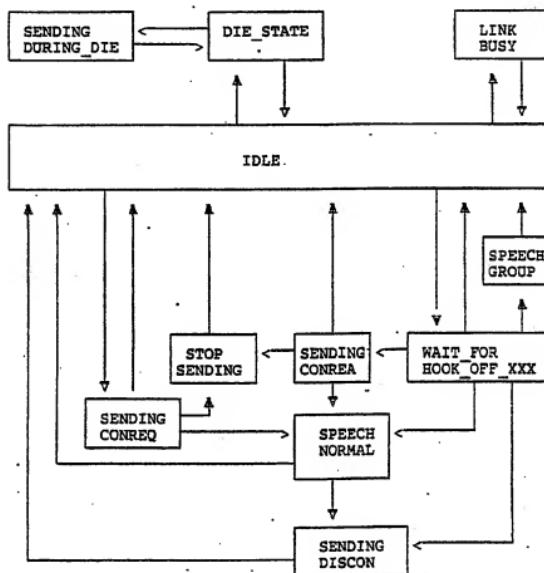
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1.5 STATE DIAGRAM



WAIT_FOR_HOOK_OFF_XXX can be in three different states depending on the received speech request, as follows:

STATEWHEN RECEIVING

WAIT_FOR_HOOK_OFF_NORMAL

CONREQ, ADDCONREQ, SOSCONREQ or EXTCONREQ

WAIT_FOR_HOOK_OFF_FAST

CONFAST, ADDCONFAST or SOSCONFAST

WAIT_FOR_HOOK_OFF_GROUP

CONORD

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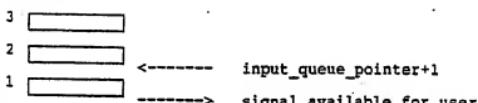
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1.6 QUEUE HANDLING

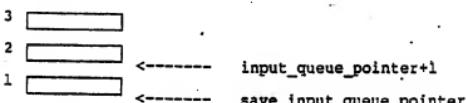
input queue:



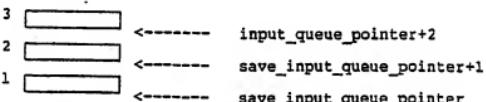
Input_signal:



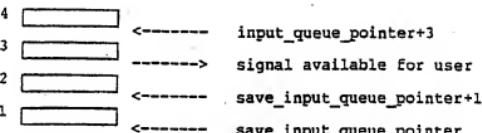
Save_signal:



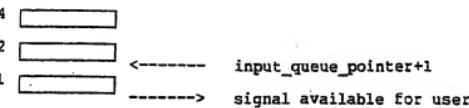
Input_signal and save_signal:



Input_signal :



Input_signal :



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2 LOGICAL DESCRIPTION

2.1 Start of program

This program have two different modes, MOBITEX mode and MANUAL mode. In MANUAL mode, the network layer is stopped. When MOBITEX mode is activated from MANUAL mode the network layer should be restarted.

```

NETWORK_LAYER
P_activation_handling
next_state = "idle"
emergency_flag = FALSE
IF permanent_list is not correct THEN
  make MPAK_BORN
  send MPAK_to_transmit to LINK
  next_state = "link_busy"
  reset grouplist and flexlist
  set NOT grouplist_received_flag
ENDIF
LOOP
IF manual_mode THEN
  MOBITEX_network_layer inactivated
  activated = FALSE
  handle manual mode
ELSE
  wait for input signal
  IF emergency_flag THEN
    P_look_for_emergency
  ENDIF
CASE signal
  WHEN MPAK_to_transmit from APP
    P_MPAK_FROM_APP
  WHEN MPAK_to_retransmit from APP
    P_MPAK_TO_RETRANSMIT
  WHEN MPAK received from LINK
    P_REC_MPAK_FROM_LINK
  WHEN MPAK_transmitted from LINK
    P_MPAK_TRANSMITTED
  WHEN MPAK_not_transmitted from LINK
    P_MPAK_NOT_TRANSMITTED
  WHEN hook_on from APP
    P_HOOK_ON_handling
  WHEN hook_off from APP
    P_HOOK_OFF_handling
  WHEN hook_off_timeout

```

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```
P_timeout_handling
WHEN roaming from LINK
  P_roaming_handling
WHEN activation from LINK
  P_activation_handling_link
WHEN activation_timeout
  P_activation_timeout_handling
WHEN power_off from APP
  P_power_off_handling
WHEN manual_mode_on
  P_manual_mode_on_handling
WHEN power_off_timeout
  set power_off_ready
WHEN manual_mode_on_timeout
  set manual_mode
WHEN buffer_full
  P_buffer_full_handling
ENDCASE
ENDIF
ENDLOOP
END_NETWORK_LAYER
```

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```
2.1.1 P_LOOK_FOR_EMERGENCY
P_look_for_emergency
    emergency_signal = FALSE
    WHILE NOT emergency_signal THEN
        CASE MPAK.type
            WHEN SOS,SOSINFO,SOSACK,SOSCONREQ,SOSCONFEST
                emergency_signal = TRUE
            WHEN OTHERWISE
                save_signal
                input_signal
        ENDCASE
    ENDWHILE
END_P_look_for_emergency
```

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2.2 P_MPAK_FROM_APP

```

P_MPAK_FROM_APP
IF NOT buffer_full_flag THEN
CASE next_state

WHEN idle
CASE MPAK.class
WHEN PSUBCOM,PSOSCOM
P_check_format
IF format = true THEN
send MPAK_to_transmit to LINK
next_state = LINK_BUSY
ELSE
send returned_MPAK_with_code:INCORRECT to APP
ENDIF
WHEN CSUBCOM
P_check_format
IF format = true THEN
P_check_and_send_CSUBCOM
ELSE
send returned_MPAK_with_code:INCORRECT to APP
ENDIF
WHEN DTESERV
P_check_format
IF format = true THEN
P_check_and_send_DTESERV
ELSE
send returned_MPAK_with_code:INCORRECT to APP
ENDIF
ENDCASE
WHEN die state
IF MPAK.class = DTESERV THEN
P_check_format
IF format = true THEN
P_check_and_send_DTESERV
ELSE
send returned_MPAK_with_code:INCORRECT to APP
ENDIF
ELSE
send returned_MPAK_with_code:NOT_SENT_DIE
ENDIF
WHEN wait_for_hook_off_normal,
wait_for_hook_off_fast,
wait_for_hook_off_group
IF MPAK.class = CSUBCOM THEN
P_check_format
IF format = true THEN
CASE MPAK.type
WHEN CONREA
P_hook_off_handling
WHEN DISCON
P_hook_on_handling
WHEN OTHERWISE

```

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```

        send returned_MPAK_with_code:NOT_SENT_SPEECH
    ENDCASE
ELSE
    send returned_MPAK_with_code:INCORRECT to APP
ENDIF
ELSE
IF MPAK.class = PSOSCOM THEN
    save_signal
    make_hook_on_signal
    P_HOOK_ON_handling
ELSE
    send returned_MPAK_with_code:NOT_SENT_SPEECH to APP
ENDIF
ENDIF
WHEN sending_conreq,sending_conrea,speech_normal,speech_group
IF MPAK.class = CSUBCOM THEN
    P_check_format
    IF format = true THEN
        CASE MPAK.type
        WHEN DISCON
            P_hook_on_handling
        WHEN OTHERWISE
            send returned_MPAK_with_code:NOT_SENT_SPEECH
        ENDCASE
    ELSE
        send returned_MPAK_with_code:INCORRECT to APP
    ENDIF
ELSE
    IF MPAK.class = PSOSCOM THEN
        CASE next_state
        WHEN sending_conreq,sending_conrea
            save_signal
            send_order_to_return_MPAK to LINK
            next_state = stop_sending
        WHEN speech_normal,speech_group
            save_signal
            make_hook_on_signal
            P_HOOK_ON_handling
        ENDCASE
    ELSE
        send returned_MPAK_with_code:NOT_SENT_SPEECH
    ENDIF
ENDIF
WHEN OTHERWISE
    save_signal
ENDCASE
ELSE
CASE MPAK.class
WHEN PSUBCOM,PSOSCOM
    P_check_format
    IF format = true THEN
        send MPAK_to_transmit to LINK
        next_state = LINK_BUSY
    ELSE
        send returned_MPAK_with_code:INCORRECT to APP
    ENDIF
ENDIF

```

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```
WHEN OTHERWISE
    send returned_MPak_with_code:NOT_SENT_BUFFER_FULL
    ENDCASE
ENDIF
END_P_MPak_FROM_APP
```

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Version	Date	Page
1990-02-23 A MTS09C.2		
2.2.1 F_CHECK_FORMAT		
F_check_format		
This routine checks and completes the format of this MPAK to be correct according to RL-09 Appendix A. A correct MPAK will be returned with format = TRUE. An incorrect MPAK will be returned with format = FALSE.		
END_F_check_format		
2.2.2 P_CHECK_AND_SEND_DTESERV		
P_check_and_send_DTESERV		
CASE MPAK.type		
WHEN LOGINREQ		
IF MPAK.type dependent in our flexlist THEN		
send returned_MPAK_with_code:PERSONAL_MAN_EXIST to APP		
ELSE		
IF more space in our flexlist		
MPAK.sender = MCU_MAN		
send MPAK_to_transmit to LINK		
next_state = LINK_BUSY		
ELSE		
send returned_MPAK_with_code:FLEXLIST_FULL		
ENDIF		
ENDIF		
WHEN VICESOSRX,SOSRX		
IF MPAK.sender in our flexlist THEN		
send MPAK_to_transmit to LINK		
next_state = LINK_BUSY		
ELSE		
send returned_MPAK_with_code:PERSONAL_MAN_NOT_EXIST to APP		
ENDIF		
WHEN LOGOUT		
remove MPAK.sender from our flexlist		
MPAK.type dependent = MCU MAN		
send MPAK_to_transmit to LINK		
next_state = LINK_BUSY		
WHEN ACTIVE,INACTIVE		
send MPAK_to_transmit to LINK		
next_state = LINK_BUSY		
WHEN OTHERWISE		
send returned_MPAK_with_code:INCORRECT to APP		
ENDCASE		
END_P_check_and_send_DTESERV		

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2.2.3 P_CHECK_AND_SEND_CSUBCOM

```
P_check_and_send_CSUBCOM
CASE "MPAK.type"
WHEN CONREQ, ADDCONREQ, SOSCONREQ, EXTCONREQ,
CONFAST, ADDCONFAST, SOSCONFAST
    MPAK.line = 0
    MPAK.connection_identity = next MPAK.connection_identity
    SPEECH_REG.part_here = MPAK.sender
    SPEECH_REG.otherF_part = MPAK.addressee
    SPEECH_REG.line = MPAK.line
    SPEECH_REG.conn_id = MPAK.connection_identity
    send MPAK_to_transmit to LINK
    next_state = sending_conreq

WHEN DISCON
    send MPAK DISCON with
        MPAK.sender = SPEECH_REG.part_here
        MPAK.addressee = SPEECH_REG.other_part
        MPAK.line = SPEECH_REG.line
        MPAK.connection_identity = SPEECH_REG.conn_id
    send MPAK_to_transmit to LINK
    next_state = sending_discon

WHEN OTHERWISE
    ignore_signal

ENDCASE

END_P_check_and_send_CSUBCOM
```

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2.3 P_MPNAK_TO_RETRANSMIT

```

P_MPNAK_to_retransmit

CASE next_state
WHEN idle
    CASE MPNAK.class
    WHEN PSUBCOM,PSOSCOM
        P_check_format
        IF format = true THEN
            send MPNAK_to_retransmit to LINK
            next_state = LINK_BUSY
        ELSE
            send returned_MPNAK_with_code:INCORRECT to APP
        ENDIF
    WHEN OTHERWISE
        send returned_MPNAK_with_code:INCORRECT to APP
    ENDCASE
WHEN die_state
    send returned_MPNAK_with_code:NOT_SENT_DIE
WHEN wait_for_hook_off_normal,
    wait_for_hook_off_fast,
    wait_for_hook_off_group
    IF MPNAK.class = PSOSCOM THEN
        save_signal
        make_hook_on signal
        P_HOOK_ON_handling
    ELSE
        send returned_MPNAK_with_code:NOT_SENT_SPEECH to APP
    ENDIF
WHEN sending_conreq,sending_conrea,speech_normal,speech_group
    IF MPNAK.class = PSOSCOM THEN
        CASE next_state
        WHEN sending_conreq,sending_conrea
            save signal
            send_order_to_return_MPNAK to LINK
            next_state = Stop_sending
        WHEN speech_normal,speech_group
            save signal
            make_hook_on signal
            P_HOOK_ON_handling
        ENDCASE
    ELSE
        send returned_MPNAK_with_code:NOT_SENT_SPEECH
    ENDIF
WHEN OTHERWISE
    save_signal
ENDCASE
END_P_MPNAK_to_retransmit

```

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2.4 P_REC_MPAP_FROM_LINK

P_REC_MPAP_FROM_LINK

```

activated = TRUE
CASE MPAK.class
WHEN PSUBCOM,PSOSCOM
    IF F_get_rec_man = MCU_MAN or in flexlist or in grouplist THEN
        send MPAK_received to APP
    ELSE
        P_unknown_handling_normal
    ENDIF
WHEN CSUBCOM
    P_REC_MPAK_CSUBCOM_FROM_LINK
WHEN DTESERV
    IF F_get_rec_man = MCU_MAN or in flexlist or in grouplist THEN
        CASE MPAK.state
            WHEN ok_from_mail
                P_REC_MPAK_DTESERV_FROM_LINK_NORMAL
            WHEN OTHERWISE
                ignore signal
        ENDCASE
    ENDIF
    ELSE
        P_unknown_handling_normal
    ENDIF
ENDCASE
END_P_REC_MPAK_FROM_LINK

```

2.4.1 P_UNKNOWN_HANDLING_NORMAL

```

P_unknown_handling_normal
CASE next_state
WHEN idle
    set MPAK.UNKNOWN_F = 1
    send MPAK_to_transmit to LINK
    next_state = "link_busy"
WHEN die_state
    set MPAK.UNKNOWN_F = 1
    send MPAK_to_transmit to LINK
    next_state = "sending_during_die"
WHEN OTHERWISE
    save_signal
ENDCASE
END_P_unknown_handling_normal

```

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2.4.2 P_REC_MP4K_DTESERV_FROM_LINK_NORMAL

```

P_REC_MP4K_DTESERV_FROM_LINK_NORMAL
CASE MP4K.type
WHEN LOGINRA
    Add personal subscription MAN to the flexlist
    send MP4K received to APP
WHEN LOGINREF
    send MP4K received to APP
WHEN LOGOUTRD
    remove personal subscription MAN from the flexlist
    send MP4K_received to APP
WHEN DIE
    IF next_state = idle or die_state THEN
        next_state = die_state
        send die to APP
    ELSE
        save_signal
    END
WHEN LIVE
    IF next_state = idle or die_state THEN
        next_state = idle
        send live to APP
    ELSE
        save_signal
    END
WHEN GROUPLIST
    replace grouplist
    set grouplist_received_flag
    send MP4K_received to APP
    send group list information to data link layer
WHEN AREALIST
    send area list information to data link layer

```

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```

WHEN ROAMORD,FLEXREQ,INFOREQ,ESNREQ
  IF next_state = idle or die_state THEN
    CASE MPAK.type
      WHEN ROAMORD  make MPAK.type ROAM
      WHEN FLEXREQ  make MPAK.type FLEXLIST
      WHEN INFOREQ  make MPAK.type INFO
      WHEN ESNREQ   make MPAK.type ESNINPO
    ENDCASE
    send MPAK_to_transmit to LINK
    CASE next_state
      WHEN idle       next_state = link_busy
      WHEN die_state  next_state = sending_during_die
    ENDCASE
  ELSE
    save_signal
  ENDIF
  WHEN FLEXLIST
    replace flexlist,
    send MPAK_received to APP
  WHEN TIME
    send MPAK_received to APP
  WHEN OTHERWISE
    ignore signal
  ENDCASE MPAK
END_P_REC_MPAK_DTESERV_FROM_LINK_NORMAL

```

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2.4.2.1 F_GET_REC_MAN

```

F_get_rec_man
CASE MPAK.state
WHEN ok,from mail
    F_get_rec_man = MPAK.addressee
WHEN OTHERWISE
    F_get_rec_man = MPAK.sender
ENDCASE MPAK.state
END_F_get_rec_man

```

2.4.3 P_REC_MPAK_CSUBCOM_FROM_LINK

```

P_REC_MPAK_CSUBCOM_FROM_LINK
CASE next_state
WHEN idle
    P_REC_MPAK_CSUBCOM_FROM_LINK_IDLE
WHEN link_busy,sending_during_die,stop_sending
    save_signal
WHEN die state
    P_REC_MPAK_CSUBCOM_FROM_LINK_DIE
WHEN wait_for_hook_off_normal,
    wait_for_hook_off_fast,
    wait_for_hook_off_group
    P_REC_MPAK_CSUBCOM_FROM_LINK_WAIT
WHEN speech_normal,speech_group
    P_REC_MPAK_CSUBCOM_FROM_LINK_SPEECH
WHEN sending_conreq
    CASE MPAK.type
        WHEN CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
            CONFAST,ADDCONFAST,SOSCONFEST,CONORD
            save signal
            send_order_to_return_MPAK_to_LINK
            next_state = stop_sending
        WHEN OTHERWISE
            ignore_signal
    ENDCASE MPAK
WHEN sending_conreq
    IF MPAK.type DISCON THEN
        send_MPAK_received_to_APP
        send_order_to_return_MPAK_to_LINK
        next_state = stop_sending
    ELSE
        ignore_signal
        send_order_to_return_MPAK_to_LINK
        next_state = stop_sending
    ENDIF
WHEN sending_discon
    save_signal
    send_order_to_return_MPAK_to_LINK
    next_state = stop_sending
ENDCASE
END_P_REC_MPAK_CSUBCOM_FROM_LINK

```

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<p>Cantel Mobitex</p>	<p>Sr No 53/1056-A 296 5171/2 Ue</p> <p>Recd Date 1990-02-23 Tmr A Fc File MTS09C.2</p>
	<p>2.4.3.1 P_REC_MP4K_CSUBCOM_FROM_LINK_IDLE</p> <pre> P_REC_MP4K_CSUBCOM_FROM_LINK_IDLE CASE MP4K.type WHEN CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ CASE MP4K.state WHEN ok IF F_get_rec_man = MCU_MAN or in flexlist start 60 second timer for hook off SPEECH_REG.part_here = MP4K.addressee SPEECH_REG.other_part = MP4K.sender SPEECH_REG.line = MP4K.line SPEECH_REG.conn_id = MP4K.connection_identity send MP4K_received_to APP next_state = wait_for_hook_off_normal ELSE P_unknown_handling_csubcom ENDIF WHEN OTHERWISE send speech_off to LINK ENDCASE MP4K.state WHEN CONFFAST,ADDCONFAST,SOSCONFFAST CASE MP4K.state WHEN ok IF F_get_rec_man = MCU_MAN or in flexlist start 10 second timer for hook off SPEECH_REG.part_here = MP4K.addressee SPEECH_REG.other_part = MP4K.sender SPEECH_REG.line = MP4K.line SPEECH_REG.conn_id = MP4K.connection_identity send MP4K_received_to APP next_state = wait_for_hook_off_fast send speech_on to LINK ELSE P_unknown_handling_csubcom ENDIF WHEN OTHERWISE send speech_off to LINK ENDCASE MP4K.state WHEN CONORD CASE MP4K.state WHEN ok IF F_get_rec_man in grouplist start 60 second timer for hook off send MP4K_received_to APP next_state = wait_for_hook_off_group send speech_on to LINK ELSE send speech_off to LINK ENDIF WHEN OTHERWISE send speech_off to LINK ENDCASE MP4K.state </pre>
<p>Bidders</p> <hr/> <p></p> <hr/> <p>Rapport</p>	
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```

WHEN OTHERWISE
    send speech_off to LINK
ENDCASE MPAK
END_P_REC_MPak_CSUBCOM_FROM_LINK_IDLE

```

2.4.3.2 P_UNKNOWN_HANDLING_CSUBCOM

```

P_unknown_handling_csubcom
    send speech_on to LINK
    make MPAK DISCON with
        MPAK.sender = received_MPak.addressee
        MPAK.addressee = received_MPak.sender
        MPAK.line = received_MPak.line
        MPAK.connection_identity =
            received_MPak.connection_identity
    MPAK.UNKNOWN_F = 1
    send MPAK_to_transmit to LINK
    next state = sending_discon
END_P_unknown_handling_csubcom

```

2.4.3.3 P_REC_MPak_CSUBCOM_FROM_LINK_DIE

```

P_REC_MPak_CSUBCOM_FRON_LINK_DIE
CASE MPAK.type
WHEN CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
CONFAST,ADDCONFAST,SOSCONFAST
CASE MPAK.state
WHEN ok
    send speech_on to LINK
    make MPAK DISCON with
        MPAK.sender = received_MPak.addressee
        MPAK.addressee = received_MPak.sender
        MPAK.line = received_MPak.line
        MPAK.connection_identity =
            received_MPak.connection_identity
    IF F_get_rec_man = MCU_MAN or in flexlist
        send MPAK_to_transmit to LINK
    ELSE
        set UNKNOWN_F = 1 in MPAK DISCON
        send MPAK_to_transmit to LINK
    ENDIF
    next state = sending_during_die
WHEN OTHERWISE
    -send speech_off to LINK
ENDCASE MPAK.state
WHEN OTHERWISE
    send speech_off to LINK
END_P_REC_MPak_CSUBCOM_FROM_LINK_DIE

```

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Replay

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2.4.3.4 P_REC_MP4K_CSUBCOM_FROM_LINK_WAIT

```
P_REC_MP4K_CSUBCOM_FROM_LINK_WAIT
CASE MP4K.type
WHEN DISCON
    reset hook_off timeout
    send speech_off to LINK
    send MP4K_received to APP
    next_state = idle
WHEN CONORD
    ignore_signal
    IF next_state < > wait_for_hook_off_group THEN
        reset hook_off timeout
        send speech_off to LINK
        next_state = idle
        make MP4K DISCON
        send MP4K_received to APP
    ENDIF
ENDCASE
END_P_REC_MP4K_CSUBCOM_FROM_LINK_WAIT
```

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2.4.3.5 P_REC_MPAC_CSUBCOM_FROM_LINK_SPEECH

```

P_REC_MPAC_CSUBCOM_FROM_LINK_SPEECH
CASE MPAC.type
WHEN CONREQ, ADDCONREQ, SOSCONREQ, EXITCONREQ,
CONFAST, ADDCONFFAST, SOSCONFFAST
    CASE MPAC.state
        WHEN no_transfer,illegal,congest,error,busy
            send speech_off to LINK
            send MPAC received to APP
            next_state = idle
        WHEN OTHERWISE
            ignore_signal
            make MPAC DISCON
            send MPAC received to APP
            send speech_off to LINK
            next_state = idle
    END CASE MPAC.state
WHEN DISCON
    send MPAC received to APP
    send speech_off to LINK
    next_state = idle
WHEN CONORD
    ignore_signal
    IF next_state < > speech_group THEN
        make MPAC DISCON
        send MPAC received to APP
        send speech_off to LINK
        next_state = idle
    ENDIF
WHEN OTHERWISE
    ignore_signal
    make MPAC DISCON
    send MPAC received to APP
    send speech_off to LINK
    next_state = idle
END CASE
END_P_REC_MPAC_CSUBCOM_FROM_LINK_SPEECH

```

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2.5 P_MPAK_TRANSMITTED

```

P_MPAK_TRANSMITTED
activated = TRUE
CASE MPAK.class
WHEN PSUBCOM,PSOSCOM,DTESERV
CASE next_state
WHEN link_busy
    next_state = idle
WHEN sending_during_die
    next_state = die_state
ENDCASE
IF MPAK.UNKNOWN_F = 0 THEN
    IF MPAK.class = DTESERV THEN
        CASE MPAK.type
        WHEN LOGINREQ,SOSRX,VICESOSRX
            send returned_MPAK_with_code:SENT to APP
        WHEN INACTIVE
            IF power_off THEN
                set power_off_ready
            ENDIF
            IF manual_mode_on received THEN
                set manual_mode
            ENDIF
        ENDIF
    ELSE
        send returned_MPAK with code:SENT to APP
        IF (MPAK.class = PSUBCOM) AND (buffer_full_flag) THEN
            make_MPAK_INACTIVE
            send MPAK_to transmit to LINK
            next_state = link_busy
        ENDIF
        MPAK.class
    ENDIF MPAK.UNKNOWN_F
WHEN CSUBCOM
CASE MPAK.type
WHEN CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
    CONFAST,ADDCONFAST,SOSCONFEST
    send speech_on to LINK
    send returned_MPAK with_code:SENT to APP
    next_state = speech_normal
WHEN CONREA
    send speech_on to LINK
    send returned_MPAK with_code:SENT to APP
    next_state = speech_normal
WHEN DISCON
    send speech_off to LINK
    send returned_MPAK with_code:SENT to APP
    IF next_state = sending_during_die THEN
        next_state = die_state
    ELSE
        next_state = idle
    ENDIF
ENDCASE MPAK
ENDCASE MPAK.class
END_P_MPAK_TRANSMITTED

```

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2.6 P_MPAK_NOT_TRANSMITTED

```

P_MPAK_NOT_TRANSMITTED
CASE MPAK.class
WHEN PSUBCOM,PSOSCOM,DTESERV
    CASE next_state
        WHEN link_busy
            next_state = idle
        WHEN sending_during_die
            next_state = die_state
        WHEN stop_sending
            next_state = idle
    ENDCASE
    IF MPAK.UNKNOWN_F = 0 THEN
        IF MPAK.class = DTESERV THEN
            CASE MPAK.type
                WHEN LOGINREQ,SOSRX,VICESOSRX
                    send returned_MPAK_with_code:NOT_SENT to APP
                WHEN INACTIVE
                    IF power_off THEN
                        set power_off_ready
                    ENDIF
                    IF manual_mode_on received THEN
                        set manual_mode
                    ENDIF
            ENDCASE
        ELSE
            send returned_MPAK_with_code:NOT_SENT to APP
        ENDIF MPAK.class
    ENDIF MPAK.UNKNOWN_F
WHEN CSUBCOM
    CASE MPAK.type
        WHEN CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ,
            CONFFAST,ADDCONFFAST,SOSCONFFAST
            IF next_state = sending_conreq THEN
                send speech_off to LINK
            ENDIF
            next_state = idle
        WHEN CONREA
            send speech off to LINK
            next_state = idle
        WHEN DISCON
            send speech off to LINK
            IF next_state = sending_during_die THEN
                next_state = die_state
            ELSE
                next_state = idle
            ENDIF
        ENDIF
    ENDCASE MPAK
    send returned_MPAK_with_code:NOT_SENT to APP
ENDCASE MPAK.class
END_P_MPAK_NOT_TRANSMITTED

```

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2.7 P_HOOK_ON_HANDLING

```

P_HOOK_ON_handling
CASE next_state
WHEN wait_for_hook_off_normal,
    wait_for_hook_off_fast,
    wait_for_hook_off_group
        reset hook_off_timeout
        P_timeout_handling

WHEN sending_conreq,sending_conrea
    save_signal
    send_order_to_return_MPAK to LINK
    next_state = stop_sending

WHEN speech_normal
    make MPAK_DISCON with
        MPAK.sender = SPEECH_REG.part_here
        MPAK.addressee = SPEECH_REG.other_part
        MPAK.line = SPEECH_REG.line
        MPAK.connection_identity = SPEECH_REG.conn_id
    send MPAK_to_transmit to LINK
    next_state = sending_discon

WHEN speech_group
    send speech off to LINK
    next_state = idle

WHEN idle
    IF line connection request received THEN
        make MPAK DISCON with
            MPAK.sender = SPEECH_REG.part_here
            MPAK.addressee = SPEECH_REG.other_part
            MPAK.line = SPEECH_REG.line
            MPAK.connection_identity = SPEECH_REG.conn_id
        send MPAK_to_transmit to LINK
        next_state = sending_discon
    ELSE
        ignore_signal
    ENDIF
WHEN OTHERWISE
    ignore_signal
ENDCASE next_state
END_P_HOOK_ON_Handling

```

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2.8 P_TIMEOUT_HANDLING

```
P_timeout_handling
CASE next_state
WHEN wait_for_hook_off_normal,wait_for_hook_off_fast
    send speech on to LINK
    make MPAK DISCON with
        MPAK.sender = SPEECH_REG.part_here
        MPAK.addressee = SPEECH_REG.other_part
        MPAK.line = SPEECH_REG.line
        MPAK.connection_identity = SPEECH_REG.conn_id
    send MPAK to transmit to LINK
    next_state = sending_discon

WHEN wait_for_hook_off_group
    send speech off to LINK
    next_state = idle

WHEN OTHERWISE
    ignore_signal
ENDCASE next_state
END_P_timeout_handling
```

2.9 P_HOOK_OFF_HANDLING

```
P_HOOK_OFF_handling
CASE next_state
WHEN wait_for_hook_off_normal
    reset hook_off timeout
    make MPAK CONREA with
        MPAK.sender = SPEECH_REG.part_here
        MPAK.addressee = SPEECH_REG.other_part
        MPAK.line = SPEECH_REG.line
        MPAK.connection_identity = SPEECH_REG.conn_id
    send MPAK to transmit to LINK
    next_state = sending_conrea

WHEN wait_for_hook_off_fast
    reset hook_off timeout
    next_state = speech_normal

WHEN wait_for_hook_off_group
    reset hook_off timeout
    next_state = speech_group

WHEN OTHERWISE
    ignore_signal
ENDCASE next_state
END_P_HOOK_OFF_handling
```

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2.10 P_ROAMING_HANDLING

```
P_roaming_handling
  IF next_state = idle or die_state THEN
    IF grouplist_received_flag THEN
      make MPAR ROAM
    ELSE
      make MPAR BORN
    ENDIF
    send MPAK to transmit to LINK
  CASE next_state
  WHEN idle
    next_state = link_busy
  WHEN die_state
    next_state = sending_during_die
  ENDCASE
  ELSE
    save_signal
  ENDIF
END_P_roaming_handling
```

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2.11 P_ACTIVATION_HANDLING

```
P_activation_handling
  IF NOT buffer_full_flag THEN
    activated = FALSE
    start activation timer with 'active_delay_power_on'
  ENDIF
END_P_activation_handling
```

2.12 P_ACTIVATION_HANDLING_LINK

```
P_activation_handling_link
  IF NOT buffer_full_flag THEN
    activated = FALSE
    start activation timer with 'active_delay_lost_contact'
  ENDIF
END_P_activation_handling_link ...
```

2.13 P_ACTIVATION_TIMEOUT_HANDLING

```
P_activation_timeout_handling
  IF next_state = idle or die_state THEN
    IF NOT activated THEN
      make MPAK ACTIVE
      send MPAK to transmit to LINK
    CASE next_state
      WHEN idle
        next_state = link_busy
      WHEN die_state
        next_state = sending_during_die
    ENDCASE
  ENDIF
  ELSE
    save_signal
  ENDIF
END_P_activation_timeout_handling
```

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2.14 P_POWER_OFF_HANDLING

```
P_power_off_handling
power_off_received
start power_off timer
CASE next_state
WHEN idle-
    make MPAK INACTIVE
    send MPAK_to_transmit to LINK
    next_state = link_busy
WHEN die_state
    make MPAK INACTIVE
    send MPAK_to_transmit to LINK
    next_state = sending_during_die
WHEN speech_normal,speech_group,wait_for_hook_off_normal,
    wait_for_hook_off_fast,wait_for_hook_off_group,
    sending_conreq,sending_discon,sending_conreq
    disconnect the speech (according to current state)
    make MPAK INACTIVE
    send MPAK_to_transmit to LINK
    next_state = link_busy
WHEN OTHERWISE-
    save_signal
ENDCASE
END_P_power_off_handling
```

2.15 P_MANUAL_MODE_ON_HANDLING

```
P_manual_mode_on_handling
manual_mode_on_received
start manual_mode_on_timer
CASE next_state
WHEN idle-
    make MPAK INACTIVE
    send MPAK_to_transmit to LINK
    next_state = link_busy
WHEN die_state
    make MPAK INACTIVE
    send MPAK_to_transmit to LINK
    next_state = sending_during_die
WHEN speech_normal,speech_group,wait_for_hook_off_normal,
    wait_for_hook_off_fast,wait_for_hook_off_group,
    sending_conreq,sending_discon,sending_conreq
    disconnect the speech (according to current state)
    make MPAK INACTIVE
    send MPAK_to_transmit to LINK
    next_state = link_busy
WHEN OTHERWISE-
    save signal
ENDCASE
END_P_manual_mode_on_handling
```

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2.16 P_BUFFER_FULL_HANDLING

```
P_buffer_full_handling
CASE next_state
WHEN idle-
    make MPAK INACTIVE
    send MPAK to transmit to LINK
    next_state = link_busy
WHEN die_state
    make MPAK INACTIVE
    send MPAK to transmit to LINK
    next_state = sending_during_die
WHEN speech_normal,speech_group,wait_for_hook_off_normal,
    wait_for_hook_off_fast,wait_for_hook_off_group,
    sending_conrea,sending_discon,sending_conreq
    disconnect the speech (according to current state)
    make MPAK INACTIVE -
    send MPAK to transmit to LINK
    next_state = link_busy
WHEN OTHERWISE
    save_signal
ENDCASE

send buffer_full to APP
set buffer_full_flag

END_P_buffer_full_handling
```

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3 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RL-06, 4, 6
RL-09, 7, 18

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RL-01	Arrangement of the documents
RL-02	MOBITEX System description
RL-03	General description of terminals
RL-04	Terminology
RL-05	References
RL-06.	Network operator information
RL-08	Application layer
RL-09	Network layer
RL-11	Interface requirements, fixed terminals
RL-12	Other requirements, fixed terminals
RL-16	Link layer, mobile terminals
RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

Bildtext

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REQUIREMENT SPECIFICATION

Rev. 1(9)

Urgency Priority: 1988 ET/SYS PES	Faisceau ET/SYS PES	No. No. 6/1056 - A 296 5171 Ue	Last Rev. 1(9)
Designated - Dr responsible ET/SYSC STS STI		Date Issn. 1990-02-26 E	PL. ED. MTS11HDLC.1
Responsible		Title MOBITEX HDLC interface Fixed terminal	
Cantel Mobitex			
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Version-Date 1990-02-26 E Tel. No. MTS11EDLC.1

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MTS11HDLC.1

1 INTRODUCTION

1.1 GENERAL

The designation "terminal" for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations and secondary station in HDLC.

CCITT recommendation X.21 bis is used at the physical layer and HDLC is used at the link layer. The network layer consists of MPAK's according to reference R1-09.

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2 PHYSICAL LAYER**2.1 GENERAL**

Connection is in accordance with CCITT recommendation X.21 bis.

2.2 BITRATE

For information about permitted bitrate transmission rates, please refer to reference R1-06.

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3 LINK LAYER

3.1 GENERAL

The design of the link layer follows ISO standards "High level data link control" (HDLC). See ISO 3309-1984, ISO 4335-1984 and ISO 7809-1984 for reference.

3.2 SUB-SET OF HDLC

HDLC is a comprehensive catalogue of standards for link control. The UNC 12 class, i.e. "Unbalanced operation, normal response mode" with added test function, of procedure is used for the link layer.

The MOBITEX network is the primary station and the fixed terminal is the secondary station.

3.2.1 Clarification

3.2.1.1 Commands and responses

The following commands and responses are obtained with the above class:

Command from network	Response from fixed terminal
I	I
RR	RR
RNR	RNR
SNRM	UA
DISC	DM
TEST	PRMR
	TEST

3.2.1.2 Frame size

A frame can be up to 566 octets including start and stop flag. This will allow 560 octets in an information field in an I frame.

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P. P.
MTS11HDLC.1**3.2.1.3 The use of the address field**

The address field comprises one octet. The address in the address field shall be adjustable. The factory set address shall be 11000000 (bit 1..8).

Address 11111111 is defined as the all-station address and thus all receiving data stations shall accept and action the associated frame. If the P bit is set in such a frame, the terminal shall reply with its own address as reply address.

3.2.1.4 FRMR responses

The information field in an FRMR response shall be padded with zeros so the length will be 3 octets.

3.2.1.5 TEST frames

TEST frames can contain an information field. The maximum length of that field is the same as for I-frames.

TEST frames can be transmitted and received both in NRM and NDM.

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<p>3.3 OPERATING MODES FOR THE LINK LAYER</p> <p>The link layer shall be able to assume the following modes:</p> <ul style="list-style-type: none"> o Normal response mode (NRM) according to ISO 4335 item 5.1.1. o Normal disconnected mode (NDM) according to ISO 4335 items 5.2 and 5.2.1. <p>A terminal's capacity in NDM is limited to:</p> <ul style="list-style-type: none"> - accepting the mode setting commands (SNRM or DISC) - accepting and responding to a test command - transmitting DM or TEST at a respond opportunity <p>A terminal may only change to NRM from NDM by accepting an SNRM command from the network.</p> <p>A terminal can change from NRM to NDM by accepting a DISC command from the network or through manual restart of the link control. NDM shall be the initial mode when power is switched on or when restarting the terminal.</p>					
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3.4 CONNECTION AND DISCONNECTION PROCEDURE

The link is connected in accordance with ISO 7809 item 3.4.1.1. The network transmits SNRM to the terminal. If there is no reply, the SNRM is retransmitted until an UA reply is received.

Normal disconnection of the link is in accordance with ISO 7808, item 3.4.1.2. If there is no reply from the terminal, DISC is retransmitted. This is repeated no more than 10 times or until an OA reply is received. The link is then assumed to be disconnected and the connection at the lower level can be broken.

If there are no frames to send, the link layer shall send flags continuously as soon as the physical layer is in data transmission mode.

3.5 TIME-OUT

When the terminal receives a correct frame with the P bit set to "1" (one), the reply shall commence within 50 ms. The time is calculated from when the last bit of the command's closing flag is received until the first bit of the response is transmitted.

If several frames are transmitted in sequence, the time between them shall not exceed 50 ms. This time is calculated from the last bit of a frame's closing flag to the first bit of the next frame's opening flag.

The terminal has no time-out function for recovery in the event of a link fault. The terminal however may have time-out function to inform the operator about a link fault. The time-out may not be less than 45s in NRM and 120 s in NDM.

3.6 RECOVERY FROM FAULT CONDITION

All recovery from a fault condition is carried out by the network. The terminal is first ordered to NDM and then to NRM.

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Report

Cantel Mobitex

6/1056 - A 296 5171 Ue
 1990-02-26 E MTS11HDLC.1

4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RL-06, 4
 RL-09, 3

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RL-01	-- Arrangement of the documents
RL-02	MOBITEX System description
RL-03	General description of terminals
RL-04	Terminology
RL-05	References
RL-06	Network operator information
RL-08	Application layer
RL-09	Network layer
RL-11	Interface requirements, fixed terminals
RL-12	Other requirements, fixed terminals
RL-16	Link layer, mobile terminals
RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series X, 1984 Edition (Red Book) X.21 bis

ISO-standards:

- ISO 3309-1984(E)
- ISO 4335-1984(E)
- ISO 7809-1984(E)

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A 296 5171

REQUIREMENT SPECIFICATION 1(11)

Urgent - Presented 1988 ET/SYS PES	Fachanwesen - Subject responsible ET/SYS PES	Nr. Nr. 1056 - A 296 5491 Ue	Bas. Date: Datum Date 1990-02-26 C MTS1IX25.1
Deutsche Postkarte - Correspondence approved ET/SYSC STT SW			
Bemerkung Cantel Mobitex		Title MOBITEX X.25 interface Fixed terminal	
<p>ABSTRACT</p> <p>This document is a specification of the interface for a fixed terminal with X.25 interface, connected to the MOBITEX network.</p>			
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Reprod			

A 296 5153/3

Cantel Mobitex

No.	1056 - A 296 5491 Ue
Date:	1990-02-26 13:45 C MTS11X25.1

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Cantel Mobitex		Nr. Nr. 1056 - A 296 5491 Ue
Document-Nr.	1 Rev.	Fr. Fr. 1990-02-26 C MTS11X25.1
<p><u>1. INTRODUCTION</u></p> <p>1.1 GENERAL</p> <p>The designation 'terminal' for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations for X.25 packet layer and link layer.</p> <p>Connection of a terminal with X.25-interface can be done directly to the MOBITEX network or through an X.25 network.</p> <p>CCITT recommendation X.21 bis is used at the physical layer, LAPB is used at the link layer and X.25 is used at the packet layer.</p> <p>The user data in X.25 packet layer should contain MPAKs as described in reference RI-09.</p>		
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Cantel Mobitex

No 2a	1056 - A 296 5491 Ue
Design Date	1990-02-26 C MTS11X25.1

2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendation X.21 bis.

2.2 BITRATE

For information about permitted bitrate transmission rates, please refer to reference RI-06.

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No.	No.	1056 - A 296 5491 Ue
Date	Rev.	Pn. No. 1990-02-26 C MTS11X25.1

3 LINK LAYER

The design of the link layer follows LAPB, Link Access Procedure Balanced, according to CCITT recommendation X.25.

The extended format modulo 128 is not supported.

The multilink procedure MLP is not supported.

Timeout period is T1=3 seconds.

Maximum number of outstanding frames are K=7.

Number of retransmission attempts are N2=10.

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St Nr	1056 - A 295 5491 Ue
Datum Zeit	1990-02-26 C MTS11X25.1

4 PACKET LAYER

The design of the packet layer follows CCITT recommendation X.25 for DTE with the following restrictions:

When the terminal is using direct connection there is only one logical channel. The logical channel group number should be zero and the logical channel number should be one.

When connection is made through an X.25 network, maximum number of logical channels are 8.

The delivery-bit should be set to zero in all data packets.

The qualifier-bit is ignored by the MOBITEX network.

The sequence numbering scheme of the data packets is performed modulo 8.

The standard default value for the window size is two packets. It is possible to change the default window size to 1, 3, 4, 5, 6 or 7 packets.

The standard default value for the packet size is 128 octets. It is possible to change the default packet size to 32, 64, 256, or 512 octets.

Interrupt, reject and registration packets are not supported.

The following facilities are supported:

- Flow control parameter negotiation.
- Non standard default packet size.
- Non standard default window size.
- Reverse charging. (See note 1.)
- Reverse charging acceptance. (See note 1.)

A connected terminal can communicate with MOBITEX through a permanent virtual circuit (PVC) or through a virtual circuit (VC).

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Source Date	T _{Max} 1990-02-26 C	T _{Min} P _{Max} MTS11X25.1

If no packets, in either direction, has been transmitted on the logical channel during X (default 4 and possible to change) minutes a virtual call will be cleared by the MOBITEX network if the connection is VC.

Note 1 : Only used when connected through an X.25 network.

The packet call request/incoming call and call accepted/ call connected should contain both calling DTE address and called DTE address (optional in CCITT X.25).

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4.1 Diagnostic codes																																															
<p>Coding of the restarting cause field and the diagnostic code field in a restart packet, used by the MOBITEX network and the connected terminal.</p> <table> <thead> <tr> <th><u>cause</u></th> <th><u>diagn.</u></th> <th><u>explanation</u></th> </tr> </thead> <tbody> <tr> <td>00</td> <td>17</td> <td>local procedure error</td> </tr> <tr> <td></td> <td>52</td> <td>invalid packet type for state r1</td> </tr> <tr> <td></td> <td></td> <td>time expired for restart indication</td> </tr> <tr> <td>07</td> <td></td> <td>network operational</td> </tr> </tbody> </table>			<u>cause</u>	<u>diagn.</u>	<u>explanation</u>	00	17	local procedure error		52	invalid packet type for state r1			time expired for restart indication	07		network operational																														
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68		invalid calling address																																													
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No.	1056 - A 296 5491	Ue
Date / Date	1990-02-26	C MTS11X25.1

Coding of the resetting cause field and the diagnostic code field in a reset packet, used by the MOBITEX network and the connected terminal.

<u>cause</u>	<u>diagn.</u>	<u>explanation</u>
05		local procedure error
01		invalid p(s)
02		invalid p(r)
27		invalid packet type for state d1
32		packet type not allowed (registration or interrupt packet)
35		invalid packet type on pvc channel
37		reject packet not subscribed
41		restart with nonzero in bits 1-4 in octet 1 or nonzero in bits 1-8 in octet 2
51		time expired for reset indication

Coding of the diagnostic code field in a diagnostic packet, used by the MOBITEX network and the connected terminal.

<u>diagn.</u>	<u>explanation</u>
36	packet on unassigned logical channel
38	packet too short
40	invalid general format identifier
50	time expired for clear indication
51	time expired for reset indication
52	time expired for restart indication

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Rev. File

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5 MOBITEX NETWORK LAYER

The MPAK should be placed in the user data field in one or more X.25 data packets. An MPAK should be handled as a complete packet sequence, according to CCITT's X.25 recommendation # 4.3.5.

Note: The D-bit should always be set to zero in communication with the MOBITEX network.

If the transmission of an MPAK is interrupted by a restart, reset or clear procedure the whole MPAK should be retransmitted.

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Nr. Nr.	1056 - A 296 5491 Ue
Datum-Denk	1990-02-26 C

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MTS11X25.1**6 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST**

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RI-06, 4
RI-09, 3

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RI-01	Arrangement of the documents
RI-02	MOBITEX System description
RI-03	General description of terminals
RI-04	Terminology
RI-05	References
RI-06	Network operator information
RI-08	Application layer
RI-09	Network layer
RI-11	Interface requirements, fixed terminals
RI-12	Other requirements, fixed terminals
RI-16	Link layer, mobile terminals
RI-17	Physical layer, mobile terminals
RI-18	Radio equipment, mobile terminals
RI-19	Other interfaces, mobile terminals
RI-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series X, 1984 edition (Red book) X.25 and X.21 bis

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A 296 5491

REQUIREMENT SPECIFICATION
1(17)

Uppgjort - Prepared 1988 ET/SYS PES	Färdigställande - Document prepared ET/SYS PES	No. Nr. No. 1056 - A 296 5490 Ue
Dokument Godkänt - Document approved ET/SYS STT STT		Datum - Date 1990-02-26 Rev C File MTS1IBSC.1
Beskrivning Cantel Mobitex		Title MOBITEX BSC interface Fixed terminal
<p>ABSTRACT</p> <p>This document is a specification of the interface for a fixed terminal with binary synchronous communication (BSC) interface, connected to the MOBITEX network.</p>		
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Cantel Mobitex-

No. 50	1056 - A 296 5490	Ue
Design Date	Rev	Fa File

1990-02-26 C MTS11BSC.1

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Subject

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Cantel Mobitex-		1056 - A 296 5490 Ue
Datum	1990-02-26	I Rev C
		99. Fix MTS11BSC.1
<u>1. INTRODUCTION</u>		
1.1 GENERAL		
The designation "terminal" for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations.		
CCITT recommendation X.21 bis is used at the physical layer. The link layer is IBM's BSC (binary synchronous communication), see chapter 2.		
The network layer is a character oriented MPAK (BSCPAK), see chapter 4.		
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Cantel Mobitex

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Issue Date 1990-02-26	1 Bar C	T. T. MTS11BSC.1

2 PHYSICAL LAYER

2.1 GENERAL

Connection is in accordance with CCITT recommendation X.21 bis.

2.2 BITRATE

For information about permitted bitrate transmission rates, please refer to reference RI-06.

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Nr.	1056 - A 296 5490 Ue
Comm Date	1990-02-26 C MTS11BSC.1

3 LINK LAYER

The design of the link layer follows IBM General Information - Binary Synchronous Communications, GA27-3004 with the following restrictions:

Point-to-point connection is used. The Mobitex network has a retry timeout of 3 seconds.

ITB and RVI will be handled by the Mobitex network when received, but is never transmitted.

Transparent mode is not handled by the Mobitex network.

SOH can be received but the content of the header is not interpreted. SOH is never transmitted.

The Mobitex network retransmits max 15 times.

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Cantel Mobitex		No.-Nr. 1056 - A 295 5490 Ue
Datum-Datum 1990-02-26		Urtz C MTS11BSC.1
<p><u>4 NETWORK LAYER</u></p> <p>The network layer use BSCPAK. A BSCPAK is a character-oriented MPAK, MPAKs are bit-oriented and are described in reference RI-09.</p> <p>BSCPAK is EBCDIC-coded, see chapter 6.</p> <p>All MPAK, except MPAK DATA, HPDATA and EXTPAK can be translated to BSCPAK.</p> <p>Sendlist is not handled.</p> <p>All numeric fields are right adjusted with preceding zeroes.</p> <p>BSCPAK shall be handled in the same way as corresponding MPAK.</p> <p>Maximum length for a BSCPAK is 548 octets (BSCPAK TEXT without sendlist).</p> <p>A BSCPAK may be divided into several blocks, each of which ends with ETB except the last one which ends with ETX.</p> <p>The content of the text field in a BSC-block is a BSCPAK (or part of BSCPAK) in either direction, to or from the Mobitex network.</p> <p>STX precedes and ETX ends a BSCPAK.</p>		
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MTS11BSC.1	

5 SPECIFICATION OF BSCPAK

BSCPAK shall be handled, according to reference RI-09, in the same way as corresponding MPAK. Below is a description of the translation between bit-oriented MPAK and the character oriented BSCPAK.

All BSCPAKs consist of one BSCPAK header and one part with type-dependent components.

All characters in a BSCPAK shall be in EBCDIC code.

5.1 BSCPAK, COMMON COMPONENTS

BSCPAK-field	octet	comment
sender	1- 8	only digits
addressee	9-16	only digits
class	17	only digits
extern_F	18	0 or 1
type	19-20	only digits
mailbox_F	21	0 or 1
digital_F	22	0 or 1
sendlist_F	23	0
unknown_F	24	0 or 1 (0 from Mobitex)
reserve_F	25	0
trajfstate	26	0 ... 7 (0 to Mobitex)

Length 26 octets.

Ex. sender = 123456

octet 1

0
0
1
2
3
4
5
6

octet 8

Octet 1 will be transmitted first.

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Doc No.	1056 - A 296 5490 Ue
Date Issued	1990-02-26 C

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5.2 BSCPAK COMPONENTS

The following components are described in this chapter:

TEXT
STATUS
SOSINFO
SOSACK
CONREQ
SOSCONREQ
ADDCONREQ
CONGRA
CONORD
CONREA
DISCON
EXTCONREQ
CLOOPON
CLOOPOFF
LOGINREQ
LOGINRA
LOGINREF
LOGOUT
LOGOUTORD
ACTIVE
INACTIVE
DIE
LIVE
VICESOSRX
SOSRX
GROUPLIST
FLEXREQ
FLEXLIST
TIME

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Cantel Mobitex-

No.	1056 - A 296 5490	Ue
Gen Date	1990-02-26	Rev C
		F. For MTS11BSC.1

* TEXT without address list:

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
text	37-	all characters included in Mobitex textcode (EBCDIC- coded), 1-512 characters

Length 37-548 octets.

* STATUS without address list:

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
status code	37-39	only digits 000 ... 255

Length 39 octets.

* SOSINFO

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
static emergency information	37-	all characters included in Mobitex textcode (EBCDIC- coded), 0-256 characters
dynamic emergency information	37-	all characters included in Mobitex textcode (EBCDIC- coded), 0-256 characters

Length 36-548 octets.

* SOSACK

BSCPAK-field	octet	comment
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)
emergency acknowledgement status	37-39	decimal digits 000...255

Length 39 octets.

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Cantel Mobitex-

No No	1056 - A 296 5490	Ue
Date Date	1990-02-26 C	PC File MTS11BSC.1

* CONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* SOSCONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* ADDCONREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255
additional information	33-52	all characters included in Mobitex textcode (EBCDIC- coded)

Length 52 octets.

* CONGRA

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

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Cantel Mobitex

No. No.	1056 - A 296 5490	Ue
Design. Date	1990-02-26	1 Rev C
		PL. P.R. MTS11BSC.1

* CONORD

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* CONREA

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* DISCON

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255

Length 32 octets.

* EXTCONREQ

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)
connection identity	30-32	decimal digits 000..255
subscr. no. in ext. network	33-52	decimal digits

Length 52 octets.

* CLOOPON

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)

Length 29 octets.

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Cantel Mobitex-

No.	1056 - A	296 5490	Ue
Date	1990-02-26	1 Sat	7-7-2
			MTS11BSC.1

* CLOOPOFF

BSCPAK-field	octet	comment
bscpak-header	1-26	
line number	27-29	decimal digits 000..255 (000 from terminal)

Length 29 octets.

* LOGINREQ

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits
password	35-42	all characters included in Mobitex textcode (EBCDIC- coded)

Length 42 octets.

* LOGINGRA

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

* LOGINREF

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

* LOGOUT

BSCPAK-field	octet	comment
bscpak-header	1-26	
MAN	27-34	only decimal digits

Length 34 octets.

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Cantel Mobitex		No 1056 - A 296 5490 Ue
Datum-Bew	1990-02-26	FCC ID MTS11BSC.1
* LOGOUTORD		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26 <u>MAN</u> 27-34 only decimal digits		
Length 34 octets.		
* ACTIVE		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26		
Length 26 octets.		
* INACTIVE		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26		
Length 26 octets.		
* DIE		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26		
Length 26 octets.		
* LIVE		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26		
Length 26 octets.		
* VICESOSRX		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26		
Length 26 octets.		
* SOSRX		
<u>BSCPAK-field</u> octet comment <u>bscpak-header</u> 1-26		
Length 26 octets.		

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NR-2a	1056 - A 296 5490	Ue
Date Recd	1990-02-26	Rev C
		Fl. Fl.
		MTS11BSC.1

* GROUPLIST

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
number of MAN	27-28	1..15
MAN 1	29- 36	only decimal digits
MAN 2	37- 44	only decimal digits
MAN 3	45- 52	only decimal digits
MAN 4	53- 60	only decimal digits
MAN 5	61- 68	only decimal digits
MAN 6	69- 76	only decimal digits
MAN 7	77- 84	only decimal digits
MAN 8	85- 92	only decimal digits
MAN 9	93-100	only decimal digits
MAN 10	101-108	only decimal digits
MAN 11	109-116	only decimal digits
MAN 12	117-124	only decimal digits
MAN 13	125-132	only decimal digits
MAN 14	133-140	only decimal digits
MAN 15	141-148	only decimal digits

Length 148 octets.

* FLEXREQ

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	

Length 26 octets.

* FLEXLIST

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
number of MAN	27	1..7
MAN 1	28-35	only decimal digits
MAN 2	36-43	only decimal digits
MAN 3	44-51	only decimal digits
MAN 4	52-59	only decimal digits
MAN 5	60-67	only decimal digits
MAN 6	68-75	only decimal digits
MAN 7	76-83	only decimal digits

Length 83 octets.

* TIME

<u>BSCPAK-field</u>	<u>octet</u>	<u>comment</u>
bscpak-header	1-26	
time	27-36	decimal digits (YYMMDDHHMM)

Length 36 octets.

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Cantel Mobitex-

No No	1056 - A 296 5490	Ue
Source Date	1990-02-26	Rec
	C	F, F, MTS11BSC.1

6 TRANSLATION BETWEEN ASCII AND EBCDIC**ASCII EBCDIC**

09	05
0A	25
0C	0C
0D	0D
20	40
21	5A
22	7F
23	7B
24	5B
25	6C
26	50
27	7D
28	4D
29	5D
2A	5C
2B	4E
2C	6B
2D	60
2E	4B
2F	61
30	F0
31	F1
32	F2
33	F3
34	F4
35	F5
36	F6
37	F7
38	F8
39	F9
3A	7A
3B	5E
3C	4C
3D	7E
3E	6E
3F	6F
40	7C
41	C1
42	C2
43	C3
44	C4
45	C5
46	C6
47	C7
48	C8
49	C9
4A	D1
4B	D2
4C	D3
4D	D4
4E	D5

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Cantel Mobitex-

Sr No	1056 - A 296 5490	Ue
Entered Date	I Rev	Pl. F.c
1990-02-26	C	MTS11BSC.1

4F D6
50 D7
51 D8
52 D9
53 E2
54 E3
55 E4
56 E5
57 E6
58 E7
59 E8
5A E9
5B 4A
5C E0
5D 4F
5E 5F
5F 6D
60 79
61 81
62 82
63 83
64 84
65 85
66 86
67 87
68 88
69 89
6A 91
6B 92
6C 93
6D 94
6E 95
6F 96
70 97
71 98
72 99
73 A2
74 A3
75 A4
76 A5
77 A6
78 A7
79 A8
7A A9
7B C0
7C 6A
7D D0
7E A1

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Cantel Mobitex-

St. No	1056 - A 296 5490 Ue
Document Date	1990-02-26 C
F. F. MTS11ESC.1	

7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RL-06, 4
RL-09, 6, 7

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RL-01	Arrangement of the documents
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RL-05	References
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RL-09	Network layer
RL-11	Interface requirements, fixed terminals
RL-12	Other requirements, fixed terminals
RL-16	Link layer, mobile terminals
RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

The following references are made in this document:

CCITT recommendations series V, 1984 Edition(Red books)X.21 bis.

IBM General Information - Binary Synchronous Communications, GA27-3004.

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A 29251533

Document number
REQUIREMENT SPECIFICATION End Date
1(7)

Urgent - Priorized	Fachabteilung - Bereich verantwortlich	Revidiert
1988 ET/SYS PES	ET/SYS PES	
Dokument/Gehärtet - Der Rezipient erkennt		
ET/SYSC STT STT		
Benennung:		
Cantel Mobitex -		
ABSTRACT		
<p>This document is a specification of the interface for a fixed terminal with MOBITEX Asynchronous Communication (MASC) interface, connected to the MOBITEX network.</p>		
<hr/> <div style="float: left; width: 33%; border-right: 1px solid black; padding-right: 10px;">Büdkers</div> <div style="float: left; width: 33%; border-right: 1px solid black; padding-right: 10px;"> </div> <div style="float: left; width: 33%;"> </div>		
<hr/> <div style="float: left; width: 33%; border-right: 1px solid black; padding-right: 10px;">Reprod</div> <div style="float: left; width: 33%; border-right: 1px solid black; padding-right: 10px;"> </div> <div style="float: left; width: 33%;"> </div>		

A 296 S1536

Cantel Mobitex

Ref No	1056 - A 296 5516 Ue
Date Recd	1 st Recd 1990-02-26 D
P:	MTC11MASC.1

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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST	7

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Cantel Mobitex-

Dr. Nr.	1056 - A 296 5516 Ue
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Pl. F.4 MTS11MASC.1	

1 INTRODUCTION

1.1 GENERAL

The designation "terminal" for a fixed terminal in the MOBITEX network correspond to DTE in CCITT recommendations.

CCITT recommendation V.24 is used at the physical layer and MASC interface is used at the link layer (reference RI-19 is used for link layer MASC). The network layer consists of MPAK's according to reference RI-09.

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2 PHYSICAL LAYER**2.1 GENERAL**

Connection is in accordance with CCITT recommendation V.24/V.28.

Note: The physical layer of MASC is not directly compatible with the physical layer in the masc interface of a mobile terminal.

However this can be done by connecting the following signals in the mobile unit.

105	_____
106	_____
107	_____
108/2	_____
109	_____

2.2 BITRATE

For information about permitted bitrate transmission rates, please see reference R1-06.

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3 LINK LAYER

3.1 GENERAL

The link layer sends, controls and acknowledge information between network and terminal. When faults are detected, the link layer handles retransmission.

The design of the link layer follows PROTOCOL FOR MASC TYPE TERMINALS, which is described in reference RI-19.

The data in information frame is MOBITEX packets (MPAK) which are described in reference RI-09.

3.2 FRAMES USED IN MASC

There are two different types of frames, control frames and information frames (see reference RI-19).

The following control frames are used:

- ACK Acknowledgement
- NACK Negative acknowledgement
- RACK Request for repetition of the latest sent ACK
- SENS Communication link control
- SACK Acknowledgement of a received SENS

Note: The network will not send the frame SENS by default.

Information frames are used with the following commands:

- B parameters in machine interface
- M send/receive MPAK
- E answer to an invalid command
- F P terminal MAN request and answer
- F Q masc device identity

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Date: Date 1990-02-26 D MTS11MASC.1

3.3 TIMEOUT

The masc interface uses two timers, which are described in reference RI-19.

Note: The network will handle the "30 seconds timeout" as follows:

If no answer is received within 30 seconds, the network will return the frame to the sender. The network will then try to start up the line with a B-command.

3.4 START WITH NO SUBSCRIPTION NUMBER

The terminal has the possibility to ask the network about the valid subscription number. When the line is in the connected mode, the terminal can ask the network about MOBITEX subscription number.

The terminal sends the F P command and receives the answer F PMAN from the network. The terminal will also receive an identification of the network in the F Q command.

The commands F P and F Q are described in reference RI-19.

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Cantel Mobitex

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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

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RL-09, 3, 5
RL-19, 3, 5, 6

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RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series V, 1984 Edition (Red books) V.24 and V.28

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Dokument-Nr.:
REQUIREMENT SPECIFICATION
1(7)

Project Name: ET/SYS PES	Facilities/Service: ET/SYS PES	No. No. 1056 - A 296 5454 Ue
Document Name: ET/SYS STT STT	Date Date 1990-02-27	Page Page C MTS11MPAD.1
<p align="center">Cantel Mobitex</p>		
<p align="center">ABSTRACT</p> <p>This document describes the connection of an asynchronous terminal to the MPAD service in the MOBITEX network.</p>		
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Cantel Mobitex

No N°	1056 - A 296 5454 Ue
Date Date	1990-02-27 C MTS11MPAD.1

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2.3 PRINTER EQUIPMENT (optional)	4
2.4 BITRATE	4
3 PROTOCOL FOR TERMINAL	5
3.1 CONTROL SEQUENCES FROM TERMINAL TO MPAD	6
3.2 CONTROL SEQUENCES FROM MPAD TO TERMINAL	6

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Cantel Mobitex

1056 - A 296 5454 Ue
1990-02-27 C MTS11MPAD.1

1 INTRODUCTION

1.1 GENERAL

The MPAD communicates with the terminal one character at a time with a start-stop protocol. The purpose with the MPAD service is to let customers use a standard terminal for communication with the MOBITEX network.

The designation "terminal" for a fixed terminal in the MOBITEX network corresponds to DTE in CCITT recommendations.

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Cantel Mobitex-		1056 - A 296 5454 Ue
1990-02-27	C	MTS11MPAD.1
<u>2 PHYSICAL LAYER</u>		
2.1 GENERAL		
Connection is in accordance with CCITT recommendations V.24/V.28.		
2.2 TERMINAL EQUIPMENT		
An asynchronous terminal of start-stop type for serial data transmission is used. The communication uses 1 start bit, 8 data bits, 1 stop bit and no parity. The screen should be 24 lines x 80 columns. The terminal should have an advanced video option installed to use the reversed video facility.		
If the MPAD-connected terminal has a printer port or auxiliary-port, a printer can be connected to this port. Messages to/from the terminal can be directed to this printer if the terminal can interpret the printer-port setting commands described in chapter 3.		
2.3 PRINTER EQUIPMENT (optional)		
The printer should have at least 24 columns, preferably 80 columns width. The transmission rate and communication type depends on the available printer-port on the terminal. The printer should be able to use the same character-set as the terminal, see chapter 3.		
2.4 BITRATE		
For information about permitted transmission rates, please refer to reference RI-06.		
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Ref No:	1056 - A 296 5454 Ue
Print Date	1990-02-27 C

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3 PROTOCOL FOR TERMINAL

The terminal should comply with ANSI/VT100 according to the following specifications that is a subset of ANSI X3.41 1974 and ANSI X3.64 1979.

The terminal should be able to :

- * transmit and receive all characters described in MOBITEX text code (please refer to reference RI-06).
- * transmit ASCII-character 127 (DEL).
- * receive ASCII-character 7 (bell) and then give an audible signal.
- * receive ASCII-character 10 (LF) and then do a line-feed.
- * receive ASCII-character 13 (CR) and then do a carriage return.
- * generate the control sequences described in chapter 3.1
- * interpret the control sequences described in chapter 3.2

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Cantel Mobitex-		N° N 1056 - A 296 5454 Ue <small>Date Date File F. P. L.</small> 1990-02-27 C MTS11MPAD.1
3.1 CONTROL SEQUENCES FROM TERMINAL TO MPAD		
<p>The following control sequences should preferably be generated by arrow-marked keys.</p>		
ESC O A (arrow up) ESC O B (arrow down) ESC O C (arrow right) ESC O D (arrow left)		
<p>The following control sequences should preferably be generated by the keys on an auxiliary keypad.</p>		
ESC O p (0) ESC O q (1) ESC O r (2) ESC O s (3) ESC O t (4) ESC O u (5) ESC O v (6) ESC O w (7) ESC O x (8) ESC O y (9) ESC O m (dash) ESC O l (=lowercase L)(comma) ESC O n (period) ESC O M (ENTER) ESC O P (PF1) ESC O Q (PF2) ESC O R (PF3) ESC O S (PF4)		
3.2 CONTROL SEQUENCES FROM MPAD TO TERMINAL		
ESC = Set terminal in keypad application mode ESC 7 Save cursor ESC 8 Restore cursor ESC [7 m Set reverse video ESC [0 m All video attributes off ESC [5 i Enter printer controller mode ESC [4 i Exit printer controller mode ESC [0 k Erase line after cursor ESC E Next line ESC [20 h Set new line mode ESC [x;y H Move cursor to line x and column y ESC [? 1 (=one) h Set cursor key mode ESC [2 J Erase all of the display		
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Ref. No.	1056 - A 296 5454 Ue
Date	1990-02-27
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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

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RI-17	Physical layer, mobile terminals
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RI-20	Other requirements, mobile terminals

The following external references are made in this document:

CCITT recommendations series V, 1984 Edition (Red books) V.24 and V.28

ANSI X3.41 1974
ANSI X3.64 1979

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REQUIREMENT SPECIFICATION

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Urgent Project 1988 ET/SYS Pes	Fachberater / Leiter Projekt ET/SYS Pes	Nr. Nr. 1056 - A 296 5176 Ue	Zus. Seite
Deutsche Gedächtnis-Dokumentation ET/SYS STT SII		Datum / Date 1990-02-26 C	Rev. / Fc. F.s. MTS12.1
Besitzung		Titel MOBITEX Other requirements, Fixed terminals	
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Cantel Mobitex™

No. No.
1056 - A 296 5176 Ue
Date of issue | Rev. |
1990-02-26 C MTS12.1

T A B L E O F C O N T E N T S

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2 ELECTRICAL SAFETY	3
3 SPECIFICATION OF LINE CONNECTION	3
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Report

A 296 5155-3

Cantel Mobitex-

No. 1056 - A 296 5176 Ue
 Series Date Rev. F. No.
 1990-02-26 C MTS12.1

1 GENERAL

A fixed terminal is connected with a line interface for packet switching and line connection for line connection traffic (primarily speech). If the fixed terminal is connected to the mains, there are certain requirements for electrical safety.

2 ELECTRICAL SAFETY

For information about electrical safety requirements, please refer to RI-06.

3 SPECIFICATION OF LINE CONNECTION

A fixed terminal should permit line connection traffic as a complement to message traffic. For this to be possible, it is necessary to have a real time connection between terminal and network in addition to the message traffic interface. A connection of this type can be used for transmitting speech for example.

For information about line connection requirements, please refer to RI-06.

TYPE OF CONNECTION: 4 wire speech connection with one speech direction per line pair.

CONNECTION: ISO DIS 8877 plug of European or U.S. type.

FREQUENCY RANGE: 300 - 3400 Hz

RECEIVER LEVEL DIRECTION -15 -- -30 dBm

SENDER LEVEL DIRECTION -10 -- -23 dBm

SIGNAL/NOISE RATION REC./SEND.: Greater than 40 dB

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Cantel Mobitex-

No. No. 1056 - A 296 5176 Ue
Datum Date 1990-02-26 Rec. MTS12.1

4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

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RL-20	Other requirements, mobile terminals

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Cantel Mobitex

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EXPLANATION AND MODIFICATIONS

This chapter has been newly added. It is an addendum providing a preliminary specification of additional requirements for portable terminals designed for operation on the Mobitex network. The primary motivation for this addendum is the need to provide a low power operating mode for portable units, to extend the operating time of their self-contained batteries. Because enhancements have been made to network signalling protocols over the air interface, these additional requirements will have some effect on the operation of mobile units as well. A careful review of this chapter is therefore required of all terminal designers and manufacturers.

Since the addendum document was printed, several changes have been made to the protocol. They will be included in a future revision of the ERTEL - provided specification. These changes, which should be applied to the MTS 15.1 document immediately following, are detailed below so that this very important new information can be brought to the attention of interested parties in a timely manner.

1. Section 3.5, page 8: the first paragraph should be changed to read:
 - If the terminal has lost consecutive <SVP6> signals over a period less than 60 seconds, it should remain in the operating state to synchronize again. If the terminal has not succeeded in synchronizing within 60 seconds, it should initiate the roaming procedure.
2. Section 3.6, page 12: the two paragraphs under the heading "Evaluation of other base stations" should be changed to read:

The evaluation of base stations on the CURRENT-SYSTEM-CHANNEL should be based on the average received signal strength over a time period indicated in <SVP6> (default value, 60 seconds).

The integration time for evaluating base stations on other channels is indicated in <SVP6> (default value, 3 RSSI-PERIODS).
3. Section 3.8.1, page 13; the second paragraph under the heading "UP LINK TRAFFIC" should be changed to read:

For uplink traffic the terminal should enter the OPERATING state and then follow the normal access rules, i.e., wait for a <FRI> signal and then choose a random slot in which to transmit.
4. Section 3.10, page 17: This section deals with voice operation and may be disregarded.

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<p>Cantel Mobitex</p> <p>5. Section 4, pages 25 and 28: Note that the <SVP5> and <SVP6> may contain up to 186 MANs each. A parameter will be added in the currently unused portion of the primary block of <SVP5> and <SVP6> to indicate the number of MANs in the mail list or traffic list, respectively.</p> <p>6. Section 4, pages 28 and 29: parameters will be added in the currently unused portion of the primary block of <SVP6> to indicate signal strength evaluation times for the CURRENT-SYSTEM-CHANNEL (default 60 seconds) and other channels (default 3 RSSI-PERIODS). (See item 2. above).</p> <p>7. Section 4, page 29: the entry for *TRANSACTION-TIME* should be changes to read:</p> <p style="padding-left: 40px;">States the time the terminal should stay in OPERATING state after (1) reception of a message from the network, and (2) transmission of a message to the network. (0-255) X 250 ms. Default value: 40 (10 seconds). TRANSACTION-TIME starts after transmitting or receiving an <ACK>, respectively.</p> <p>8. Section 6, pages 35 and 36: the following three items listed as design recommendations have been changed to design requirements, and their functionality must be included in portable units:</p> <p style="padding-left: 40px;">Automatic change to mobile terminal operation (page 35)</p> <p style="padding-left: 40px;">User notification of 'lost contact' (page 36)</p> <p style="padding-left: 40px;">Display RSSI to user before transmitting (page 36)</p> <p>The remaining three items - manual selection of operating mode, prevention from automatic quick channel monitoring, and manual initiation of channel monitoring - continue to be design recommendations.</p> <p>ADDITIONAL INFORMATION</p> <p>In the "INFO" MPAK (See MTS 09A.2, pages 107 and 108), portable terminals will be defined as terminal type number 4. The INFO MPAK will also now include a parameter indicating the operating mode of the portable unit (mode = mobile terminal mode; mode 1 = battery saving mode).</p> <p>In the MASC interface (see MTS 19A.2), new commands will be added to accommodate portable terminals. Details will be provided later.</p>		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Nr.</td><td style="width: 10%;">Stk.</td><td style="width: 10%;">I</td><td style="width: 10%;">I</td></tr> <tr> <td>Sektor</td><td>Direkt</td><td>I Sat.</td><td>PC F.d.</td></tr> </table>	Nr.	Stk.	I	I	Sektor	Direkt	I Sat.	PC F.d.
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Sektor	Direkt	I Sat.	PC F.d.							
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Reprint										

ADDENDUM
PROTOCOL FOR HAND-HELD PORTABLE
TERMINALS FOR USE IN MOBITEX

P R E L I M I N A R Y S P E C I F I C A T I O N .

ABSTRACT

This document specifies additional requirements for hand-held portable terminals to be connected to the MOBITEX system.

An interface for hand-held portable terminals, where power conservation is one prime objective, is defined.

This document should be considered as an ADDENDUM to the MOBITEX Terminal Specification (MTS) for 8 kbps mobile terminals, LZBA 703 1001, R1A.

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No. No.	1056 - A 296 6084 Ue
Document Date	90-05-11 FA3 MTS15.1

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Blockout

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1 INTRODUCTION

This document specifies additional requirements for hand-held portable terminals to be connected to the MOBITEX system.

It should be considered as an ADDENDUM to the complete MOBITEX Terminal Specification for 8 kbps mobile terminals, LZBA 703 1001, RIA.

If certain requirements are made for hand-held portables these are made in this document. It could either be new additional requirements or new requirements that replaces ones that are made in the specification for ordinary mobile terminals.

2 GENERAL DESCRIPTION

A hand-held portable terminal is basically a mobile terminal and should therefore conform to the requirements for mobile terminals, but with the additional ability to go into low power drain operating mode and wakeup when required to receive messages from the network.

When the hand-held has received its messages it goes asleep again.

One limitation for portables in this mode is that messages to these terminals may be delayed during the time when the portable is asleep.

Whenever a hand-held wants to send a message it immediately wakes up, waits for a free-signal and sends the message. The terminal then stays awake for a period of time in order to be able to receive a quick message response.

The roaming procedure is essentially the same as for ordinary mobiles, but is controlled from separate sweep-parameters for hand-held terminals. The hand-held terminals performs the base evaluation during its awake time.

Replies:

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This protocol for hand-held terminals defines four new subtypes of the sweep-signal, <SVP>. These subtypes are numbered from 3 to 6.

<SVP3> - Sweep frame of subtype 3

Includes roaming parameters and channel list used by hand-held terminals. <SVP3> corresponds to <SVP1> used by mobile terminals.

<SVP4> - Sweep frame of subtype 4

Contains channel numbers and channel types used in fleet division procedure. <SVP4> corresponds to <SVP2> used by mobile terminals.

<SVP5> - Sweep frame of subtype 5

Contains a list of terminal MAN that has messages stored in the network mailbox.

<SVP6> - Sweep frame of subtype 6

Contains a list of terminal MAN or Group MAN that will have traffic from the network during this sweep cycle.

This sweep frame also contains timing parameters for synchronization and message transfer.

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3 OPERATING PRINCIPLES

3.1 START UP PROCEDURE

When the portable is powered up for the first time and/or when it has lost synchronization with the network or lost important information/parameters, it should consider itself to be in normal mobile terminal mode and act according to that.

When the hand-held has found a system channel on a base station to use, received the relevant parameters from the base and synchronized to it, the terminal should send MPAK ROAM or ACTIVE according to the roaming procedure.

The hand-held always has the possibility to go to normal mobile terminal mode, e.g. when the terminal is put in a power charger or for a major data transaction session when you want to be active all the time. In order to inform the network of this change of mode, the hand-held sends a new MPAK called MODE.

3.2 STATES

There are two different states that a hand-held terminal could enter when it is in the low power drain mode; STANDBY state or OPERATING state.

The STANDBY state should be considered as a 'sleeping' mode where only time keeping functions for synchronizing the terminal to the base station are in operation.

In the OPERATING state the terminal should be considered as fully operational.

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3.3 TRAFFIC LIST

The hand-held terminal is notified in a TRAFFIC LIST that traffic will sent to the terminal.

The TRAFFIC LIST contains the TERMINAL-MAN or the GROUP-MAN of those terminals that should remain in the OPERATING state in order to be available for the down-link traffic from network.

The TRAFFIC LIST is part of a new <SVP>-frame of SUBTYPE 6, denoted <SVP6>-frame.

Terminals not included in the TRAFFIC LIST may directly go back to STANDBY state in order to save battery.

3.4 MAIL LIST

Messages not acknowledged by the terminal may be stored in the network mailbox according to the conditions describes in RI-09, 8kbps MTS.

In order to inform terminals that have messages in the network mailbox, the MAIL LIST is introduced.

The MAIL LIST contains a list of those terminal MAN having messages in the mailbox. The MAIL LIST is within the <SVP>-frame of subtype 5, denoted <SVP5>.

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3.5 SYNCHRONIZATION TO THE NETWORK

Hand-held terminals using the this battery saving protocol cyclically goes from the STANDBY state to the OPERATING state.

The terminal must be synchronized to the <SVP6> (TRAFFIC LIST) sent from the network. The <SVP6> frame is sent periodically from the network on the system channels where hand-held terminals can operate and use the battery saving protocol.

The <SVP6> also contains the parameter TIME-TO-NEXT indicating the remaining period of time from this <SVP6> to the next time the terminal should enter the OPERATING state.

TIME-TO-NEXT = time from first bit (bit 1) in the framhead of the received <SVP6> to the next time the terminal should enter the OPERATING state.

The <SVP6> also contains the parameter CYCLE-TIME which is the nominal cycle time between the start of two operating states.

The length of the CYCLE-TIME parameter is a compromise between response-time requirements and power consumption requirements of the terminal.

Normally the terminal uses the TIME-TO-NEXT parameter in the <SVP6> to synchronize to the next time to enter the OPERATING state. If one or more of the <SVP6> frames are lost, the terminal should use the CYCLE-TIME parameter in order not to lose synchronization.

Once the terminal has entered the OPERATING state it remains in this state until it receives an <SVP6> frame with a TRAFFIC LIST where the terminal is not included. The <SVP6> is terminating the transmission of the sweep frames.

If the network is going to send other sweep frames when the terminals are in the OPERATING state, they will be sent prior the <SVP6> frame.

If none of the <SVP3> to <SVP6> has been received within 2 seconds from the transition to the OPERATING state, the terminal could return to STANDBY.

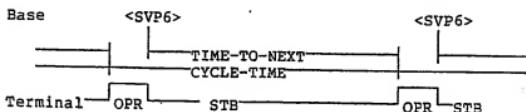
After the reception of every <SVP3> to <SVP5> the terminal stays in OPERATING state for another 2 seconds or till it receives an <SVP6>.

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If the hand-held consider itself as having lost synchronization to the network, e.g. lost of a number of consecutive <SVP6>, it should stay in OPERATING state to synchronize again.

Example 1 :

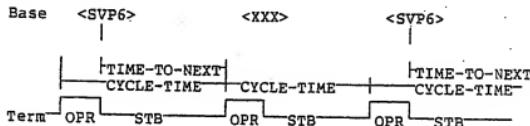
Terminal uses TIME-TO-NEXT for synchronizing.



OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Example 2 :

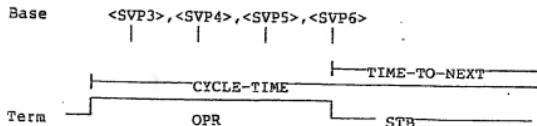
Terminal is using the CYCLE-TIME when <SVP6> is lost to keep synchronization.



OPR = terminal in OPERATING state
STB = terminal in STANDBY state

Example 3 :

Multiple sweep frame could be sent during the OPERATING state.

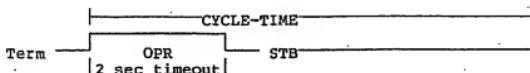


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Example 4 :

Terminal does not receive any sweep frame within 2 seconds from the start of the OPERATING state and returns to STANDBY.

Base



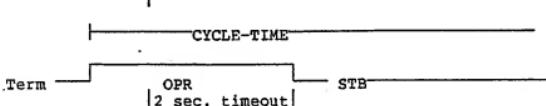
Example 5:

The terminal receives a <SVP3> but the <SVP6> is not received so the OPERATING state is terminated by the 2 second timeout.

The timeout is counted from the reception of the <SVP3> frame.

Base

<SVP3>



Pass

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3.6 ROAMING

The roaming procedure for hand-held terminals follows basically the roaming procedure for mobile terminals described in RI-16.

Since a hand-held terminal is most of the time in the STANDBY state, the normal monitoring of the roaming procedure must be carried out during the time when the terminal is in the OPERATING state. During the OPERATING state the terminal measures the averaged received signal strength and calculates a roaming value.

The system parameters controlling the roaming procedure for hand-held portables are defined in the <SVP3>-frame. This gives the possibility to have different parameters for mobile terminals (defined in the <SVPI> frame) and for hand-held portables.

In order to control the performance of the terminals roaming procedure, different roaming parameters can be set in the <SVP3>-frame from the network. Here are some examples described and the impacts on the terminals performance.

Example 1:

If SCAN_TIME = 0 the terminal only monitors the CURRENT_SYSTEM_CHANNEL during the OPERATING state.

At evaluation, if the roaming value < BAD BASE the terminal goes to the 'quick channel monitoring' procedure since no other channels has been detected.



m = monitor CURRENT_SYSTEM CHANNEL
OPR = terminal in OPERATING state
STB = terminal in STANDBY state

The other sweep frames are not shown in this figure but are coming before the <SVP6> frame if they are sent out.

3.6.1.1

3.6.2

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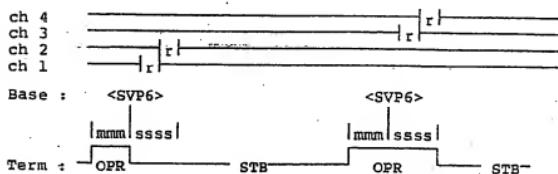
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Example 2 :

If **SCAN_TIME** = 1 ... 255, the terminal monitors other channels according to the channel list information the mobile has derived in the <SVP3> or from the default list.

The start of the scan period is only critical in that sense that the terminal must not leave the system channel and monitor another channel when it should be in OPERATING state.

The terminal should not leave CURRENT_SYSTEM_CHANNEL and monitor other channels during the sweep cycle if it is addressed in the TRAFFIC LIST.



```

m = monitor CURRENT SYSTEM CHANNEL
s = scan other system channels
r = RSSI PERIOD
OPR = terminal in OPERATING state
STB = terminal in STANDBY state

```

Please see the chapter ROAMING in R1-16 for further information.

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Criteria for leaving base :

The same criteria for leaving the CURRENT_BASE applies for a hand-held terminal as the mobile terminal but with the parameters in the <SVP3> frame. The fifth criteria (item -5-) is not valid for hand-held terminals.

Please see the chapter ROAMING in R1-16 for further information.

Evaluation of other base stations :

The evaluation of base stations on the CURRENT_SYSTEM_CHANNEL, should be based on the averaged received signal strength from at least 60 seconds or some other suitable integration time.

When evaluating other channels than the CURRENT_SYSTEM_CHANNEL, roaming values from at least three (3) RSSI_PERIODS should be averaged.

Quick channel monitoring :

In quick channel monitoring when the SCAN_TIME = 0 and when the terminal has found a channel with a roaming value > GOOD_BASE, the terminal should remain on the channel for at least 5 seconds during the measuring of received signal strength. Please refer to 'quick channel monitoring' part (item -4-) of the ROAMING chapter in R1-16.

At Power On

When the hand-held terminal is switched on it should use the stored CURRENT_SYSTEM_CHANNEL and the CURRENT_BASE.

If there is no CURRENT_BASE stored the terminal directly starts the quick channel monitoring procedure using the default list of system channels. When a CURRENT_SYSTEM_CHANNEL and a CURRENT_BASE has been found and the MPAK ROAM has been sent to the network, the terminal synchronizes to the <SVP6>-frames.

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3.7 FLEET DIVISION OF HAND-HELD PORTABLES

In order to assign a certain system channel (and/or access channel) to hand-held terminals or parts of the fleet of the hand-held terminals a <SVP>-frame of SUBTYPE 4 is introduced, denoted <SVP4>-frame. The <SVP4>-frame should be interpreted in same way as the <SVP2>-frame for mobile terminals, described in 8kbps MTS section R1-16.

3.8 MESSAGE TRANSACTIONS

3.8.1 UP LINK TRAFFIC

The access requirements for up-link traffic from a hand-held terminal are basically the same as for a mobile terminal.

A hand-held terminal that is going to transmit a message to the network enters the OPERATING state directly and waits for a valid <PRI>-frame from the network according to the 8kbps MTS.

When the terminal makes an access request for data using the <ABD>-frame, the terminal should follow the 8kbps MTS dialogues and remain in OPERATING state till the <MRM>-frame is transferred successfully or when the dialogue terminates for any reason.

After the message is successfully transferred to the network the hand-held terminal remains in OPERATING state for TRANSACTION-TIME, defined in <SVP6>, before it goes back to STANDBY state. This gives a possibility for transferring an answer back to the hand-held without any delays caused by the waiting time to the next TRAFFIC LIST transmission. This function could be considered as if a 'logical down-link channel' has been opened to the terminal for TRANSACTION-TIME.

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3.8.2 DOWN LINK TRAFFIC

Hand-held terminals having down-link traffic is addressed in the TRAFFIC LIST.

When the hand-held terminal receives a TRAFFIC LIST that contains one of its terminal addresses (TERMINAL MAN or GROUP MAN) it stays in OPERATING state and awaits one message.

When the message is successfully received the terminal stays in OPERATING state for TRANSACTION-TIME in order to be able to receive more down-link messages coming from the network. The parameter TRANSACTION-TIME is included in the <SVP6>-frame, and is the same as for up-link traffic.

If no message has been received within the TRANSACTION-TIME elapsed from the reception of the last message, the terminal can leave OPERATING state.

The terminal can also leave OPERATING state when it receives a TRAFFIC LIST without any of the terminal addressees.

When a hand-held terminal is ordered to another channel for down-link data transmission, <BRD> frame from network, the hand-held terminal should remain in the OPERATING state until the data transmission dialogue is completed according to the 8kbps MTS.

Terminals not included in the TRAFFIC LIST may directly go to STANDBY state in order to save battery.

Example 1:

Terminal is not in traffic list

Base : <SVP6> <SVP6>

Term : OPR ————— STB ————— OPR ————— STB —————

OPR = terminal in OPERATING state

STB = terminal in STANDBY state

L-222

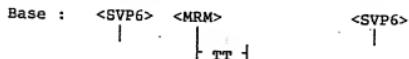
E-222

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Example 2:

Terminal is in traffic list of <SVP6> and the network has one <MRM> to transmit.



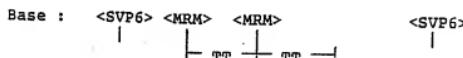
TT = TRANSACTION-TIME

OPR = terminal in OPERATING state

STB = terminal in STANDBY state

Example 3:

Terminal is in traffic list of <SVP6> and the network transmits multiple <MRM> within the sweep cycle.



TT = TRANSACTION-TIME

OPR = terminal in OPERATING state

STB = terminal in STANDBY state

Occurs

Lapsed

AUTELIST

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3.9 ACTIVATION/INACTIVATION

The hand-held terminal use of the ACTIVE/INACTIVE packet has been modified to better suit their environment and application.

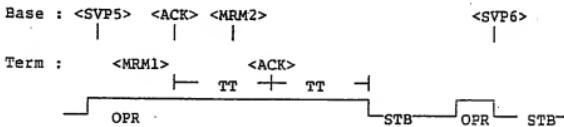
Hand-held portables used in-doors will lose contact with the network much more frequently than mobile terminals. Hand-held terminals should therefore not send ACTIVE due to 'lost contact' according to the roaming procedure since this will cause considerable system signalling overhead.

Hand-held terminals should send INACTIVE / ACTIVE when switched-off and switched-on respectively.

When a hand-held terminal is addressed in the MAIL LIST it has the possibility to empty the mailbox by sending an ACTIVE packet.

Example 1:

Terminal is in mail list of <SVP5> and the network has one or more <MRM> placed in mailbox.



TT = TRANSACTION-TIME
 OPR = terminal in OPERATING state
 STB = terminal in STANDBY state
 MRM1 = MPAK ACTIVE
 MRM2 = any MPAK from mailbox

Address:

To/From:

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3.10 LINE CONNECTION

Call set-up and disconnection procedures for line connection to a hand-held terminal follows the requirements in the 8kbps MTS.

When a hand-held terminal is called from the network for a line connection, the terminal is addressed in the TRAFFIC LIST with the TERMINAL MAN or one of the GROUP MAN. The terminal remains in the OPERATING state and follows the normal procedure for call set-up described in the 8kbps MTS. The terminal can leave the OPERATING state when the call is disconnected, according to the dialogues in the 8kbps MTS.

When a hand-held terminal initiates a call set-up for a line connection, the terminal enters OPERATING state before sending the line connection request, and stays in this state until the call is disconnected, according to the 8kbps MTS.

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4 ADDITIONAL FRAMES - DATA LINK LAYER

FRAME TYPE <SVP>, Sweep signal

APPLICATION The sweep signal is a periodically recurring signal from BASE. An <SVP> is transmitted by BASE for two reasons:

- 1) <SVP> marks the start of a sweep cycle.
- 2) <SVP> contains system parameters.

<SVP> has 2 different subtypes for mobile terminals and 4 subtypes for hand-held portable terminals :

- | | | |
|---------|---|---|
| SUBTYPE | 1 | states the values of system parameters for mobile terminals |
| | 2 | states the frequency of different channel types for mobile terminals |
| | 3 | subtype only for hand-held terminals using the battery saving protocol described in this document. This subtype contains the system parameters for the hand-held terminals. |
| | 4 | states the frequency of different channel types for hand-held terminals. |
| | 5 | includes the MAIL LIST for terminals (may be used both by mobile terminals and hand-held terminals) |
| | 6 | includes the TRAFFIC LIST and the timing parameters for hand-held terminals |

Note 1: <SVP> of subtype 1 and 2 are not described in this Addendum. Please refer to 8kbps MTS R1-16.

Note 2: For <SVPS> and <SV6>, the hand-held should use correctly received following blocks, even though the whole frame may not be correct.

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<SVP>, SUBTYPE 3

- states the values of system parameters for hand-held terminals.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	0	1	1	1	1
33	34	35	36	37	38	39	40	41	42	43	44	45	46
PRIOR		MASK				BLOCK							47
48													
49	50	51	52	53	54	55	56	57	58	59	60	61	62
													63
													64
SVPTYP													
TXPOW													
65	66	67	68	69	70	71	72	73	74	75	76	77	78
													79
													80
RSSI_PROC													
RSSI_PERIOD													
81	82	83	84	85	86	87	88	89	90	91	92	93	94
													95
													96
0	0	0	0	0	0	0	0						
MAX REP													
97													
104		105											
BASEST													
SCAN_TIME													
112													
113													
120		121											
BAD_BASE													
GOOD_BASE													
128													
129													
136		137											
BETTER_BASE													
144													
145													
PARITY													
160													

Unknown

Raprod

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	F F MTS15.1
SVPTYP	States the <SVP> subtype, value 00000011 in this case.
TXPOW	States the decrease in output power (0-255 db below nominal level) to be used by the hand-held terminal. The default value of 0 is used until this signal is received.
RSSI_PROC	States the method of the signal strength measurement: 0 = FRAME 1 = CONTINUOUS The default value is FRAME.
RSSI_PERIOD	Time used by the roaming algorithm (0-255 *20 ms). Default value: 148 (2 960 ms).
MAX REP	States the value of the variable Max_rep.
BASEST	States status of base station.
SCAN_TIME	States the length of a period (0-255 *100 ms) when the hand-held terminal scans other system channels. Default value: 30 (3 seconds).
BAD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
GOOD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
BETTER_BASE	Used by the roaming algorithm. 0-255 dB. Default value: 10.

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FOLLOWING BLOCKS

If any, they contain a list of system channels to be used in base station monitoring. A frame with a list containing new system channels completely overrides the previous frame. The channel list has the following format (as described in the MAIN DOCUMENT):

FOLLOWING BLOCK #1

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
number of channels															0
17															32 33
															48
															channel #1 - UPFREQ
															channel #1 - DOFREQ
49															64 65
															80
															channel #2 - UPFREQ
															channel #2 - DOFREQ
81															96 97
															112
															channel #3 - UPFREQ
															channel #3 - DOFREQ
113															128 129
															144
															channel #4 - UPFREQ
															channel #4 - DOFREQ
145															
															PARTITY
															160

The number of following blocks depends on the size of the list. The maximum number of channels in the list is stated in reference RL-06.

Continues with following block #2 on the next page.

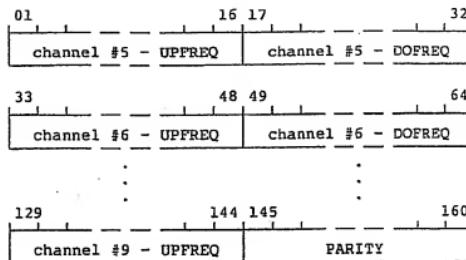
Blockset

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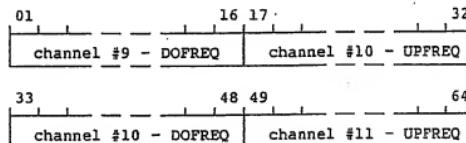
A 992 541X3

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Dw 3x1 12x1 F 5x1
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FOLLOWING BLOCK #2



FOLLOWING BLOCK #3



etc.

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<SVP>, SUBTYPE 4

- states the frequency of
different channel types for
hand-held terminals.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
MOB			0	0	0	0	1	1	1	1			
33	34	35	36	37	38	39	40	41	42	43	44	45	46
FRIQ		MASK											BLOCK
49	50	51	52	53	54	55	56	57	58	59	60	61	62
SVPTYP													63
64													
65	66	67	68	69	70	71	72	73	74	75	76	77	78
UPFREQ													80
81	82	83	84	85	86	87	88	89	90	91	92	93	94
DOPREQ													96
97	98	99	100										144
0	0	0	0	0	0								0
145													160
PARITY													

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SVPTYP States the <SVP> subtype, value 00000100
in this case.

CHTYP States the type of channel:

Value:

- 1 Local system channel opened
- 2 Not used (ignore that order)
- 3 Local system channel closed
(return to previous system
channel)
- 4 Access channel opened
- 5 Access channel closed

UPFREQ Frequency number for up frequency, i.e.
the frequency on which the terminal
transmits.

DOFREQ Frequency number for down frequency, i.e.
the frequency on which BASE transmits.

FOLLOWING BLOCK .. No following blocks in this type
of frame.

1-10000000
1-10000000
1-10000000

A 296.1155.3

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Owner Date	1 Rec
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	MTS15.1

<SVP>, SUBTYPE 5

- contains a list of terminal
MAN that has messages stored
in the network mailbox

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	0	1	1	1	
33	34	35	36	37	38	39	40	41	42	43	44	45	46
PRIOR		MASK											BLOCK
49	50	51	52	53	54	55	56	57	58	59	60	61	62
		SVPTYP				0	0	0	0	0	0	0	0
65	66	67	68	69	70	71	72	73	74	75	76	77	78
0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	82	83	84	85	86	87	88	89	90	91	92	93	94
0	0	0	0	0	0	0	0	0	0	0	0	0	0
97					104	105							112
0	0	0	0	0	0	0	0	0	0	0	0	0	0
113					120	121							128
0	0	0	0	0	0	0	0	0	0	0	0	0	0
129					136	137							144
0	0	0	0	0	0	0	0	0	0	0	0	0	0
145													160
													PARITY

SVPTYP

States the <SVP> subtype, value
00000101 in this case.

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Report

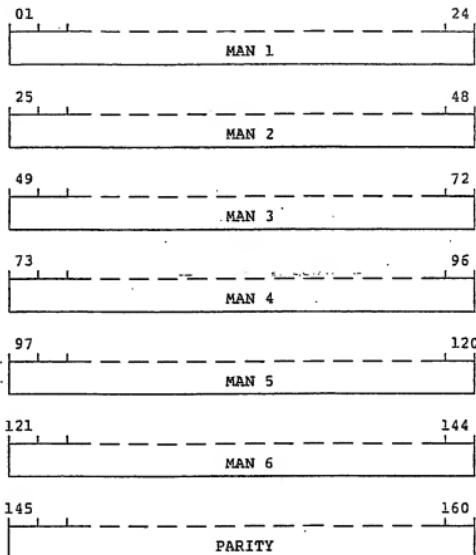
A 292 515303

1056 - A 296 6084 Ue		
90-05-11	PA3	MTS15.1

FOLLOWING BLOCKS

Containing a list of terminal
MAN that has been stored in the
network mailbox.

FOLLOWING BLOCK #1



The number of following blocks depends on the size of the list.

Continues with following block #2 on the next page.

Blocklist

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A 296 6084 Ue

1056 - A	296 6084	Ue
90-05-11	PA3	MTS15.1

FOLLOWING BLOCK #2

01	-----	24
MAN 7		
25	-----	48
MAN 8		
49	-----	72
MAN 9		
73	-----	96
MAN 10		
97	-----	120
MAN 11		
121	-----	144
MAN 12		
145	-----	160
PARITY		

etc.

Slickert

Report

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Sr. No.	1056 - A 296 6084	Ue
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<SVP>, SUBTYPE 6

- contains the timing parameters
used in synchronization and
message transactions

PRIMARY BLOCK

01 02 03	22 23 24 25 26 27 28 29 30 31 32
MOB	0 0 0 0 1 1 1 1
33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48
PRIOR	MASK
49 50 51 52 53 54 55 56	57 58 59 60 61 62 63 64
SVPTYP	CYCLE-TIME
65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
TIME-TO-NEXT	TRANSACTION-TIME
81 82 83 84 85 86 87 88	89 90 91 92 93 94 95 96
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
97	104 105
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
113	120 121
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
129	136 137
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
145	160
	PARITY

Bottoms

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A 296 6084

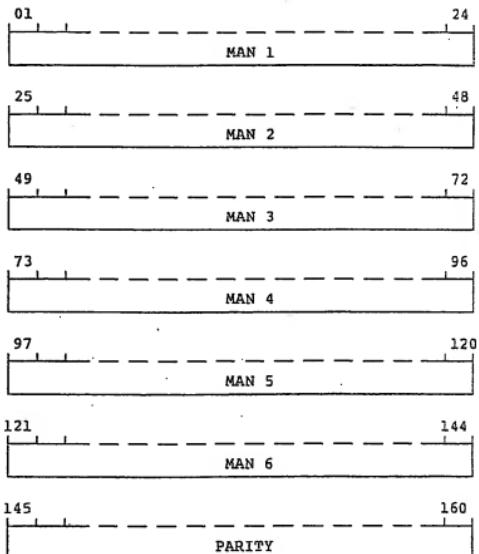
	1056 - A 296 6084 Ue
Source Date	13-
90-05-11	PA3 MTS15.1
SVPTYP	States the <SVP> subtype, value 00000110 in this case.
CYCLE-TIME	States the cycle time between two OPERATING states (0-255 x 250 ms).
TIME-TO-NEXT	States the time to the next <SVP6> frame (0-255 x 250 ms).
TRANSACTION-TIME	States the time the terminal should stay in OPERATING state after 1) reception of a message from the network and 2) transmission of a message to the network (0-255 x 250 ms). Default value: 80 (20 seconds).
A 296 6084 Ue	
Report	

1056 - A 296 6084 Ue		
90-05-11 PA3	1 st PA	MTS15.1

FOLLOWING BLOCKS

Containing a list of terminal
MAN or group MAN that are going
have down-link traffic during
this sweep cycle.

FOLLOWING BLOCK #1



The number of following blocks depends on the size of the list.

Continues with following block #2 on the next page.

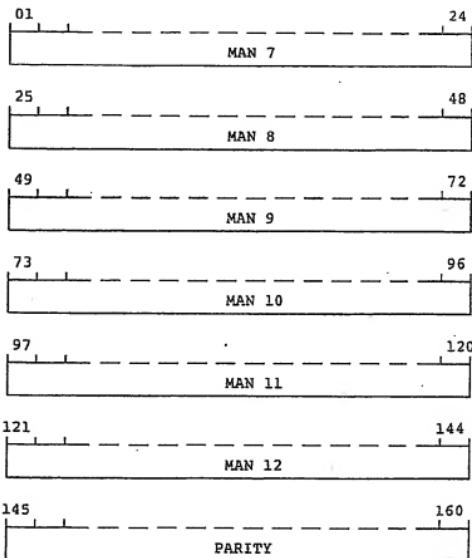
Blocks:

Revised

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Date Date	1 Km	F.C. End
90-05-11	PA3	MTS15.1

FOLLOWING BLOCK #2



etc.

E-blocks

E-parity

1056 - A 296 6084 Ue
90-05-11 PA3 MTS15.1

5 ADDITIONAL MPAK - NETWORK LAYER

A new MPAK is included for terminals using the battery saving protocol. The MPAK is used to inform the network that the terminal has changed from battery saving mode to operate as a normal mobile terminal and vice versa.

The new MPAK is within the packet class DTESERV (3) and has the packet type = 24.

MODE (mode information):

Designated sender:

The hand-held portable terminal.

Designated addressee:

The network.

Raised flags:

No raised flags.

Criteria for generating the packet:

When hand-held portable terminal changes from the battery saving protocol to operate as a mobile terminal this packet is used to inform the network.

The same packet is sent to the network, but with a different mode identifier, when the terminal enters the battery saving protocol from being operating as a mobile terminal.

Bucket:

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Date	PA3	F. F.

90-05-11 MTS15.1

The network's normal action when receiving the packet:

The network registers how the terminal operates, and forwards down-link traffic to the terminal in accordance to this. If terminal is using the battery saving protocol, the terminal is addressed in the TRAFFIC LIST.

If the terminal is operating as a mobile terminal the network sends traffic immediately to the terminal.

The terminal's normal action when receiving the packet:

The terminal does not normally receives this packet.

Length of the packet:
9 octets.

Stalecs

Report

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S-NR 1056 -	A 296 6084 Ue
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MODE as generated by the terminal:

MPAK-COMMON COMPONENT:

octet 1-3:	-----	sender: the terminal
octet 4-6:	-----	addressee : the Mobitex Network
octet 7:	0 0 0 0 0 0 0	
octet 8:	1 1 0 1 1 0 0	

TYPE DEPENDENT COMPONENT:

octet 9 :	mode identifier
-----------	-----------------

mode identifier :

- 0 = mobile terminal operation
- 1 = battery saving protocol operation
- 2-255 = reserved

Bitstart

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90-05-11 PA3 MTS15.1

6 DESIGN RECOMMENDATIONS

Manual selection of Battery saving operating mode - Mobile terminal operating mode

When the hand-held terminal is mounted into a battery charger in a car for example, it is recommended that terminal leaves the battery saving protocol operation and operates as mobile terminal. In that case the user or the terminal itself initiates the transmission of the MPAK MODE to the network. The MPAK MODE will then identify the operating mode the terminal uses.

Automatic change to mobile terminal operation.

If the terminal could not find any signalling required for the battery saving protocol operation (<SVP6>), but detects <SVPI> required for mobile terminal operation, the terminal could act as mobile terminal. The user should be informed of this so the terminal could be switched-off.

The MPAK MODE is sent to the network informing that the terminal has gone into mobile terminal operation.

Prevention from automatic quick channel monitoring

In order to prevent the automatic quick channel monitoring from continuously running or to prevent the terminal from repeated attempts to go into the quick channel monitoring, it is recommended that the user manually can switch the quick channel monitoring function off.

It is also recommended that the terminal has some kind of watchdog function implemented, limiting the operating time in quick channel monitoring mode.

Manual initiation of quick channel monitoring

If the hand-held terminal is implemented without automatic quick channel monitoring functions it is recommended that this function can be manually initiated.

Bulletin

Report

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User notification of 'lost contact'

When the terminal loses contact with network, according to roaming procedure, and goes into quick scan monitoring the operator of terminal should be notified. It is also suitable if the received signal strength indication (RSSI) is displayed to the user so positioning of the terminal could be facilitated.

RSSI when transmitting

It is recommended to display the received signal strength to the user especially when the terminal is going to transmit, so the user can move the terminal to a good location.

Blocker

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1056 - A 296 6084	De
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7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RL-06, 21
 RL-09, 6
 RL-16, 10, 11, 12, 13, 18

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RL-01	Arrangement of the documents
RL-02	MOBITEX System description
RL-03	General description of terminals
RL-04	Terminology
RL-05	References
RL-06	Network operator information
RL-08	Application layer
RL-09	Network layer
RL-11	Interface requirements, fixed terminals
RL-12	Other requirements, fixed terminals
RL-16	Link layer, mobile terminals
RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

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Documentname: REQUIREMENT SPECIFICATION
Date: 1/6/93
Ref. No.: 1(63)

Urgent - Prepared ET/SYS IK	Faxanwendung - Sonderempfehlung ET/SYS IK	Sr.-No. 9/1056 - A 296 5171/02 Ue
Dokument/Gesichter - Dokumentauskoppelung ET/SYSC-STT S97		Date: 02-26 Rev: MTS16.2
Bezeichnung Cantel Mobitex		Title: MOBITEX Data Link Layer, Mobile Terminal 8/16 kbps

ABSTRACT

This document specifies the data link layer for terminals connected to the MOBITEX network.

The mobile terminal's Data Link Layer together with the Physical Layer form a radio protocol for communication between mobile stations (MOB) and a base radio station (BASE).

The interchange of information between BASE and MOB is in the form of frames. There are 21 different types of frames.

A number of different access strategies are used in the protocol to permit the handling of a large number of mobile terminals on a few trunked channels. The most important aspects are:

- Time slots
- Selective repetition
- Priority access
- Concurrent channels
- Automatic roaming.

To achieve high transmission reliability, the frames are divided into blocks where each block is coded.

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Date Date	1990-02-26 Rev A Ed F.M.

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1 INTRODUCTION

1.1 GENERAL

The Link Layer of mobile terminals forms a link between the Network Layer and the physical radio channel with its special properties. It ensures a safe and efficient transmission path between the mobile terminal and the network, represented by the base stations. The Link Layer includes error correction facilities, access algorithms, roaming algorithms, priority facilities etc.

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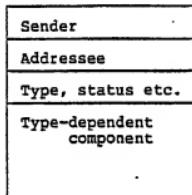
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2 INTERACTION WITH UPPER LAYERS

The upper layers handle packets of information, MPAK. The following figure presents the general appearance of an MPAK (it is fully described in reference RI-09).



The Link Layer transmits the MPAK in the form of a frame. The frame structure is defined in chapter FRAME STRUCTURE. The conversion of a packet into a frame is described in APPENDIX A.

If the Link Layer is unsuccessful in transferring an MPAK to the network, it is returned to the Network Layer with this information. The Network Layer can then request a new attempt by sending the MPAK back to the Link Layer.

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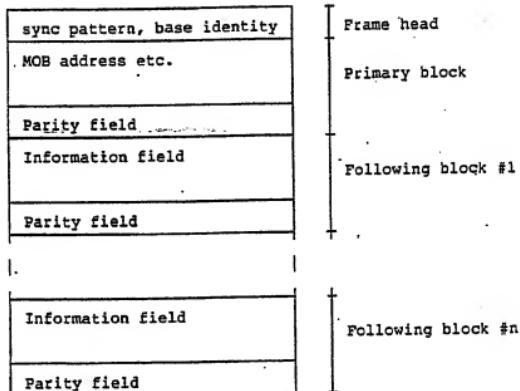
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No. 9/1056 - A 296 5171/02 Ue
 Date: 1990-02-26 1st Ver. FC: T.2
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3 FRAME STRUCTURE

3.1 PARTS OF THE FRAME

The transmission of digital information over the radio channel is performed by transmitting frames. A frame comprises a limited number of bits which are transmitted in an uninterrupted sequence. The frame consists of the following parts:



The frame head is described in detail in reference R1-17. The information and parity fields of the following blocks are described in APPENDIX A, together with the primary block.

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3.2 FRAME TYPES

There are 21 different frame types:

Name	Designation	Transmitted by	BASE	MOS
1 M frame	<MRM>	Yes	Yes	
2 Acknowledgement	<ACK>	Yes	Yes	
3 Negative acknowledgement	<NAR>	Yes	Yes	
4 Repetition request	<REQ>	Yes	Yes	
5 Repetition reply	<RES>	Yes	Yes	
6 Access request, data	<AED>	No	Yes	
7 Access request, speech	<AST>	No	Yes	
8 Access request, emergency	<AEL>	No	Yes	
9 Access permission, data	<ATD>	Yes	No	
10 Access permission, speech	<ATT>	Yes	No	
11 Access permission, emergency	<ATL>	Yes	No	
12 Change channel, data	<BRD>	Yes	No	
13 Change channel, speech	<BRK>	Yes	No	
14 Free signal	<PRI>	Yes	No	
15 Sweep signal	<SVP>	Yes	No	
16 Silence order	<TSD>	Yes	No	
17 Activity request	<AKT>	Yes	No	
18 No access permission, speech	<NAT>	Yes	No	
19 Change base station, speech	<BBT>	Yes	No	
20 Wait for channel, speech	<VKT>	Yes	No	
21 Cancel access request, speech	<AAT>	No	Yes	

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The following pages give a brief description of each frame type. Refer to Appendix A "Frames" for a complete definition of frame types.

1 M-frame

<MRM>

An <MRM> is used to transfer packets (MPAKs). The packet formats are defined in reference RI-09.

2 Acknowledgement

<ACK>

An <ACK> acknowledges a correctly received frame.

<ACK> indicates that all blocks in the frame have been correctly received. It includes the sequential number of the received frame.

3 Negative acknowledgement

<NAK>

A <NAK> requests repetition of the entire <MRM>.

<NAK> indicates that the primary block has been correctly received, but that the following blocks have been lost. It contains the sequential number of the received primary block. <NAK> results in a complete repetition of the lost <MRM>.

Note that if the number of blocks in <MRM> was 3 or more, <REB> is used instead of <NAK>.

4 Repetition request ..

<REB>

A <REB> requests repetition of erroneous blocks in an <MRM> or <RES>.

If it is found during reception that certain blocks in a frame are not correct, a request for these blocks to be repeated can be made by transmitting a <REB>. The request contains a bit map of the blocks to be repeated. This bit map refers to the original <MRM>, even during a sequence of repetitions.

<REB> contains the sequential number of the received <MRM> and results in a <RES>.

Note that if the number of blocks in <MRM> was 2 or less, <NAK> is used instead of <REB>.

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5 Repetition reply <RES>

A <RES> is the reply to a <REB>.

<RES> is a selective repetition of blocks from an <MRM>. The following blocks of the <RES> contain copies of blocks according to the bit map of the <REB>. <RES> contains the sequential number of the original <MRM>.

6 Access request, data <ABD>

An <ABD> is a request to transmit an <MRM>, containing "data" (defined in chapter "Addressing a mobile terminal"), whose length (number of blocks) exceeds the value of MAX_ACCESS. MAX_ACCESS is described in chapter "Time division".

If the length of the <MRM> exceeds MAX_ACCESS, access must be requested before the <MRM> may be sent.

The <ABD> states the number of blocks in the corresponding <MRM>.

7 Access request, speech <ABT>

An <ABT> is a request to transmit an <MRM>, containing "speech" (defined in chapter "Addressing a mobile terminal"), containing a request for a line connection whose length (number of blocks) exceeds the value of MAX_SPEECH. MAX_SPEECH is described in chapter "Time division".

If the length of an <MRM> with a connection request exceeds MAX_SPEECH, access must be requested before the <MRM> may be sent.

The <ABT> states the number of blocks in the corresponding <MRM>.

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8 Access request, emergency <ABL>

An <ABL> is a request to transmit an <MRM> containing an "emergency" (defined in chapter "Addressing a mobile terminal"), whose length exceeds the value of MAX ACCESS. MAX ACCESS is described in chapter "Time division".

If the length of the <MRM> exceeds MAX ACCESS, access must be requested before the <MRM> may be sent.

The <ABL> states the number of blocks in the corresponding <MRM>.

9 Access permission, data <ATD>

BASE replies with an <ATD> to an <ABD> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted (<ATD> received), MOB is expected to transmit an <MRM> containing a data packet.

10 Access permission, speech <ATT>

BASE replies with an <ATT> to an <ABT> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted (<ATT> received), MOB is expected to transmit an <MRM> containing a request for line connection.

11 Access permission, emergency <ATL>

BASE replies with an <ATL> to an <ABL> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted (<ATL> received), MOB is expected to transmit an <MRM> containing an emergency signal.

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12 Change channel, data <BKD>

A <BKD> orders a MOB to another channel in order to transmit or receive an <MRM>, data or emergency.

Normally the terminal returns to the original channel when the <MRM> has been transmitted or received. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKD>.

13 Change channel, speech <BSK>

A <BSK> orders a MOB to another channel in order to transmit or receive an <MRM> containing a request for line connection.

Normally the terminal returns to the original channel when the line connection is over. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BSK>.

14 Free signal <FR1>

BASE transmits a <FR1> when it is ready to handle traffic from MOB.

A free signal precedes a free cycle. A free cycle is a period of time when all of, or parts of, the total fleet of mobile terminals are collectively permitted to transmit.

15 Sweep signal <SVP>

The sweep signal is a periodically recurring signal from BASE. An <SVP> is transmitted by BASE for two reasons:

- 1 <SVP> marks the start of a sweep cycle.
- 2 <SVP> contains system parameters, such as:

- time to next <SVP>
- maximum number of repetitions
- channel list
- local system channel
- access channel

Builders

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Cantel Mobitex

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16 Silence order <TST>

Silence order is used by BASE to withdraw all access permissions during a free cycle. A MOB that is already transmitting may continue to do so, but for every other MOB the access permissions for all traffic types (emergency, speech and data) are withdrawn.

Note: Please also refer to the description of the silence signal in reference R1-17. This signal has the same meaning as the <TST>-frame but uses only the frame head and thus addresses ALL mobile terminals.

17 Activity request <AKT>

An <AKT> is used by BASE to check whether a certain MOB is active. MOB replies with an <ACK> to such a frame.

18 No access permission, speech <NAT>

BASE replies with <NAT> to an <ABT> from a MOB when, for some reason, a line connection cannot be set up (e.g. no channel is available).

19 Change base station, speech <BBT>

BASE will use <BBT>

- as a response to an <ABT> when another base station is to be used for the line connection

or

- to hand over a call in progress to another base station.

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20 Wait for channel, speech <VKT>

If no channel is immediately available, BASE may place MOB in a queue of waiting calls and reply with a <VKT> to a received <ABT>. When a speech channel becomes available, BASE indicates this by transmitting a <BKT> to MOB. If there is no free channel within reasonable time, BASE ends the session by transmitting a <NAT>.

21 Cancel access request, speech <AAT>

After having received a <VKT> from BASE, the mobile terminal may end the session by transmitting an <AAT>.

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4 TRAFFIC HANDLING**4.1 TRANSMISSION PRINCIPLES**

Transmission is carried out through the interchange of frames between MOB and BASE. Different types of transmission cases demand different behaviours by the units involved. Some of the problems considered in this chapter are:

- | | |
|----------------------------------|---|
| Access to the channel | - describes how a small number of channels can handle concurrent traffic from a large number of subscriptions at the same time. |
| Keeping contact with the network | - describes how the mobile unit maintains its contact with the network (roaming). |
| Addressing | - describes how the addressing of base radio stations, terminals and subscriptions take place. |
| Sequential numbering | - describes how repeated presentations of repeated frames are avoided. |

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9/1056 1990-02-26	A	MTS16.2

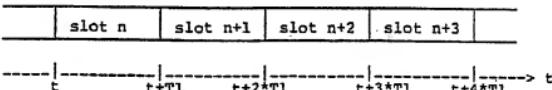
4.2 ACCESS TO THE CHANNEL**4.2.1 Time division**

A MOB, with traffic to send, is allowed to establish contact with the base radio station in special free cycles. These cycles are initiated by BASE by transmitting a <PRIV>.

This frame contains an indication of the length of the free cycle, including the following parameters:

- | | |
|-------------|--|
| Slot_length | States the length of each individual free slot. |
| Free_slots | States the total number of free slots in the current free cycle. |
| Rand_slots | States the interval for the random number generator in the MOB. |
| Max_access | States the maximum length of an <MRM>-frame, containing data or emergency, which can be sent without a preceding access request. |
| Max_speech | States the maximum length of a frame, containing a connection request, which can be sent without a preceding access request. |

In order to reduce the probability of a collision between traffic from several mobile units, the free cycle is subdivided into slots. The length of these slots (Tl) are stated by the Slot_length parameter.



By the aid of an internal clock, the mobile terminal is able to detect slot boundaries. The definition of how slot boundaries are calculated is found in reference R1-17.

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The following happens in the free slots.

- 1 Traffic initiated before the start of the free cycle must be distributed at random. A random number generator selects a slot between 1 and Rand slots. Transmission begins at the start of the selected slot.
- 2 Traffic initiated during the free cycle is sent at the beginning of the next slot.
- 3 If the <MRM> to be sent is longer than MAX_ACCESS or MAX_SPEECH, a request for access must be made. The transmission of this request is done according to rules 1 or 2 above.

If the Data Link Layer is in the speech mode (ordered by the Network Layer), an <MRM> may be sent immediately. This is done independently of any free cycles.

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4.2.2 Mobile fleet division

The access permission in the free cycle can be given to parts (subsets) of the mobile fleet according to the setting of corresponding fields in the free signal, <PRI>. This is used to reduce the number of access attempts in a free cycle. The following principles are used:

Masked addressing The address and mask fields in <PRI> are used for a binary division (1, 2, 4, 8 etc) of the mobile fleet.

Priority Is used to give access only to mobile terminals above a stated priority level.

Traffic type, FFG Is used to give access only for stated traffic types (emergency, data or speech).

In the <SVP> a channel (receiving and transmitting frequencies) and a channel type (local system or access channel) can be given. By using the addressing facilities in the <SVP> it is possible to assign a certain system and/or access channel to the whole mobile fleet or to parts of it.

The local system channel is used in much the same way as any other system channel. It is not shared by surrounding base stations and may thus be used without interference from these.

When assigned a local system channel, the mobile terminal monitors this channel until further notice or the roaming algorithm indicates that it is no longer usable.

When assigned an access channel, the mobile terminal must use this channel when it has an <MRM> to transmit. The access rules described above also apply to this channel. After the <MRM> has been acknowledged the terminal returns to the previous (local) system channel.

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4.3 ROAMING

The algorithm for selection of a suitable base is called roaming. It is designed to handle a nationwide system of base radio stations on different system channels, with either frequency or time division in their signalling. The algorithm includes two methods of channel monitoring: normal and quick.

A mobile terminal measures the received signal strength from all base radio stations. To evaluate one base station the mobile terminal calculates its roaming value. The roaming value is defined as the average received signal strength. Please see reference R1-17 for further information about how to measure received signal strength.

After a <BKT>- or a <BKD> has been received, the monitoring is disabled. It is resumed after the connection/session is ended, and the same table of evaluations as before the connection is used.

When the terminal is switched on, it uses the CURRENT_SYSTEM_CHANNEL and the CURRENT_BASE until this base becomes unsuitable according to the roaming algorithm. If no CURRENT_BASE has been stored, the terminal immediately starts the quick channel monitoring, using the default list of system channels.

Lists of system channels

The mobile terminal uses a list of system channels when it monitors the base radio stations or searches for a new base. It is either a permanent or a temporary default list (please refer to the chapter 'SYSTEM PARAMETERS TO BE STORED IN THE TERMINAL' and to reference R1-06) or the current list (stated in the <SVP>-frame).

The default list is used until a <SVP>-frame has been received. A <SVP>-frame with a new list of system channels completely overrides the old current list.

The default list is also used in the quick channel monitoring after an unsuccessful search of the current list has been made. Again, the default list is used only until a valid <SVP>-frame with the current list of system channels has been received from the new base station.

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Measurement methods

When the mobile terminal measures the received signal strength it can use two different measurement procedures: FRAME or CONTINUOUS. Which of these it should use is stated by the parameter RSSI_PROC in the <SVP>-frame.

If RSSI_PROC states FRAME the mobile terminal measures the received signal strength of the frame heads received during the RSSI_PERIOD (stated in <SVP>).

If RSSI_PROC states CONTINUOUS the mobile terminal measures the received signal strength during the entire RSSI_PERIOD.

The parameter RSSI_PERIOD includes channel switching time, and has the default value 2 960 ms, with a tolerance of +/- 10 ms.

During monitoring of current system channel and when making the final decision before choosing a new base, the terminal measures average received signal strength during the reception of frame heads.

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Normal channel monitoring

A mobile terminal measures the received signal strength from base radio stations on the CURRENT_SYSTEM_CHANNEL and calculates a roaming value for each base station.

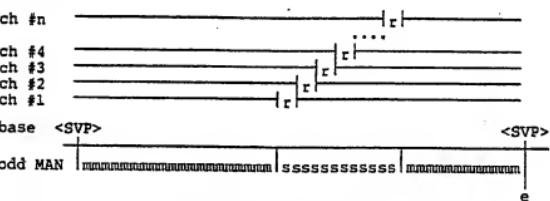
During each <SVP>-cycle (i.e. the time between two <SVP>-frames) the terminal leaves the CURRENT_SYSTEM_CHANNEL for a predefined period to monitor other channels and then return. These channels are chosen from the list of system channels (default or current). The start of the scan period depends on the terminal's own subscription number (MAN) being odd or even:

$$\begin{aligned} \text{scan start(odd)} &= \text{TIME_TO_NEXT} - 10\text{ms} - 2 * \text{SCAN_TIME} \\ \text{scan start(even)} &= \text{TIME_TO_NEXT} - 10\text{ms} - \text{SCAN_TIME} \end{aligned}$$

where

SCAN_TIME = Length of predefined scan period, including channel switching time. This is stated in the <SVP>-frame and has the default value 3 seconds, with a tolerance of +/- 10 ms..

TIME_TO_NEXT = Interval between two <SVP>-frames. This parameter is stated in the <SVP>-frame and has the default value 10 seconds.

Example:

where

m = monitor current system channel
 s = scan other system channels
 r = RSSI_PERIOD
 e = evaluation

The monitoring is cyclically repeated for all channels and every channel is monitored one RSSI_PERIOD.

For example, if the RSSI_PERIOD and SCAN_TIME have default values, the list contains 7 channels and the length of a <SVP>-cycle is 10 seconds, then the time between the scans of a specific channel from the list is 70 seconds. On the other hand, if the RSSI_PERIOD is 4 (80 ms) and SCAN_TIME is 30 (3 s) then the mobile will scan at least 30 channels during each <SVP>-cycle.

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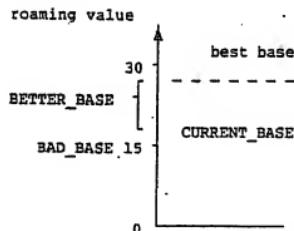
Criteria for leaving CURRENT_BASE

The mobile terminal leaves CURRENT_BASE during a <SVP>-cycle if:

- 1- roaming value (CURRENT_BASE) < BAD_BASE
BAD_BASE is stated in the <SVP>-frame and its default value is 15.
or
- 2- roaming value (best base) >
roaming value (CURRENT_BASE) + BETTER_BASE.

If this criterion is fulfilled, the mobile should remain in normal channel monitoring on the current system channel for another <SVP>-cycle. During the next scan period the mobile should measure the average received signal strength of frame heads from best base. If the roaming value still fulfills the criterion, the mobile should select this base as new CURRENT_BASE and the new channel as CURRENT_SYSTEM_CHANNEL.

The following figure shows an example where this criterion applies:



The parameter BETTER_BASE is stated in the <SVP>-frame and its default value is 10.

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The following criteria cause the mobile to leave CURRENT_BASE immediately without waiting for the end of the <SVP>-cycle:

- 3- The terminal has made MAX REP retransmissions without getting an acknowledgement from base. The value of MAX REP is stated in the <SVP>-frame.
- 4- The terminal has received a <NAT> (including an order to leave the CURRENT_BASE) from base.

And the last criterion applies when no traffic is exchanged:

- 5- The terminal has not received valid <SVP>-frames within 2 <SVP>-cycles (= 2 *TIME_TO_NEXT).

Any of the above criteria, except -2-, causes the mobile terminal to leave CURRENT_BASE and evaluate other bases.

Evaluation of other base stations

MOB first evaluates the best base (# CURRENT BASE) from the normal channel monitoring. This is done by evaluating the:

- roaming value from the last <SVP>-cycle (on CURRENT_SYSTEM_CHANNEL)
- roaming value from the last RSSI_PERIOD of a specific channel (on the other system channels)

If the base is on the CURRENT_SYSTEM_CHANNEL and have a roaming value greater than GOOD_BASE it can be directly selected as CURRENT_BASE.

But if the new base is on a new system channel the mobile shall measure the average received signal strength during the reception of frame heads on this channel for SCAN_TIME. If the measured roaming value is greater than GOOD_BASE, the mobile should select this channel as CURRENT_SYSTEM_CHANNEL and this base as CURRENT_BASE.

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Quick channel monitoring

If best base is not good enough, a quicker scanning procedure is adopted until a suitable base is found. MOB then scans its list of (current) system channels in the following way:

- 1- Begin with the first channel from the list.
- 2- Measure the average received signal strength for RSSI_PERIOD.
- 3- If the measured roaming value is greater than GOOD_BASE remain on this channel. Otherwise skip to step 6.
- 4- Measure the average received signal strength during the reception of frame heads on this channel for SCAN_TIME.
- 5- If the roaming value is greater than GOOD_BASE select this channel as CURRENT_SYSTEM_CHANNEL, the base as CURRENT_BASE and return to normal channel monitoring. Otherwise go to step 6.
- 6- Stop scanning if all channels of the list have been scanned. Otherwise choose next channel from list and repeat steps 2-5.

After MOB has scanned a number of channels from the list (please see reference R1-06), or the list is ended, the current system channel is scanned in the same manner. The scan of the list is then resumed, if the end of the list was not already reached.

If the complete current list of system channels has been searched without a new base having been chosen, the quick channel monitoring is restarted with the default list of system channels.

Re-establishing contact

When a new CURRENT_BASE has been chosen, an <MRM>-frame with roaming information is sent to it. If the new BASE is identical to the old CURRENT_BASE, an <MRM>-frame with activation information is sent instead.

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Area identification

The frame header (on the physical layer) includes an area identification used to specify geographical areas. Such an area is denoted as a traffic area and is given a unique area ID by the network.

From the network layer, the data link layer receives a list including the areas subscribed to by the user. The list also shows if the areas not subscribed to are allowed to be used, with for example higher charges, or not.

From the physical layer, the data link layer receives information about incoming roam information, i.e. area ID, base ID and weighted roaming value.

During the roaming procedure (described above), the terminal will primarily evaluate roaming information from bases belonging to the subscribed traffic areas. If the terminal is allowed to traffic other areas all bases may be considered in the roaming procedure.

In case a "non-subscribed" base is chosen (possible only in quick channel monitoring), it should be notified to the application layer, as well as when the terminal returns to a "subscribed" base.

If the terminal have not yet received the list of area IDs, the roaming procedure will evaluate all base stations.

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4.4 ADDRESSING

4.4.1 Addressing the base radio station

The base radio station is only addressed in the frame head. Further details can be found in reference RI-17.

4.4.2 Addressing a mobile terminal

Transmitting The mobile terminal's subscription number (MAN) is always used as the MOB address.

Receiving When receiving, the MOB address refers to the mobile terminal's MAN, or any MAN representing a group to which the terminal belongs. (A transferred subscription is addressed in the MPAK.)

A MAN-representing a group occurs only when receiving frame types <MRN>, <BKD>, <BRK>, <BBT> and together with a mask value of 0 in frame types <FRI>, <SVP>, <TST>. Masked addressing is described in detail in chapter 4.4.2.1.

Masked and priority addressing is used in frame types <SVP> and <TST>.

Masked, priority and traffic type addressing is used in frame type <FRI>.

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4.4.2.1 Masked addressing.

Masked addressing is only used in <SVP>, <FRI> and <TST>. In this addressing mode both the MASK and MOB fields of the frame are used. The MASK field indicates the number of bits from the beginning of the MOB field (most significant bits) that should not be considered (masked out) when comparing the MOB field with the terminal's MAN.

A MASK value different from 0 (zero) indicates that only the terminal's own MAN is to be compared with the relevant bits of the MOB field.

A MASK value of 0 (no bits masked out, all bits of MOB are relevant) indicates that the MOB field is to be compared with both the terminal subscription MAN and with the MANs of all current group numbers in the group list.

The terminal is considered to be addressed if all relevant bits of the MOB field are the same as the corresponding bits of one of the compared MANs.

A MASK value of 24 (decimal) indicates that all bits are masked out and that all mobile terminals are addressed.

Note: For <SVP> and <TST> signals the priority of the terminal must also comply with that of the signal.

For the <FRI> signal the priority and traffic type of the terminal must comply with that of the signal for the terminal to be addressed (except for emergency where priority is ignored). (See below).

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Example: Assume a frame with the following contents in the MOB and MASK fields.

(x indicates that the corresponding bit is to be ignored)

MOB field Bit no. : 1 24
Value : 101000000000101010110010

MASK field Bit no. : 1 5
Value : 11000 (24 decimal)

Addressed MAN Bit no.: 1 24
Value : xxxxxxxxxxxxxxxxxxxxxxxxx

All mobile terminals are addressed.

MASK field Bit no. : 1 5
Value : 10111. (23 decimal)

Addressed MAN Bit no.: 1 24
Value : xxxxxxxxxxxxxxxxxxxxxxxxx0

Only mobile terminal subscriptions with MAN ending with binary 0 are addressed.

MASK field Bit no. : 1 5
Value : 10110 (22 decimal)

Addressed MAN Bit no.: 1 24
Value : xxxxxxxxxxxxxxxxxxxxxxxxx10

Only mobile terminal subscriptions with MAN ending with binary 10 are addressed.

MASK field Bit no. : 1 5
Value : 00000 (0 decimal)

Addressed MAN Bit no.: 1 24
Value : 101000000000101010110010

The MASK value 00000 (zero) indicates that mobile terminals with the terminal subscription MAN, or any of its MAN numbers representing groups, identical to the MOB field are addressed.

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4.4.2.2 Priority addressing

Priority addressing is used in the frames <SVP>, <TST> and <FR1>.

A terminal subscription belongs to one of 4 priority groups. The terminal may have two priority states within each group, normal or raised. The terminal will raise its priority if it has made MAX REP retransmissions of the same frame without getting any acknowledgement from the base station.

PRIOR Field	Meaning
7 111	Priority group 4, raised priority
6 110	" , normal
5 101	Priority group 3, raised priority
4 100	" , normal
3 011	Priority group 2, raised priority
2 010	" , normal
1 001	Priority group 1, raised priority
0 000	" , normal

When receiving a frame with priority addressing, the mobile terminal is addressed if its own priority is higher than or same as the received priority.

If the terminal is to transmit an emergency signal the priority level is ignored.

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4.4.2.3 Traffic type addressing

Traffic type applies to the type of MPAK to be sent from the mobile terminal. The packets are separated into 3 traffic types:

- emergency: MPAK class PSOSCOM
- speech: MPAK class CSUBCOM
- data: All other types of MPAK

Traffic type addressing is used only in the <FR1> frame. The traffic type to which the <FR1> applies is coded into the FFG field as follows:

Value	Emergency	Speech	Data
00	yes	no	no
01	yes	no	yes
10	yes	yes	no
11	yes	yes	yes

Note: For the frames <SVP> and <TST>, both the masked address and the priority must be correct for the terminal to be addressed.

For the <FR1> to be valid, the masked address, the priority and the traffic type criteria must be met by the terminal, except for the transmission of an emergency signal where only the masked address and traffic type criteria has to be met (priority is ignored).

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4.5 SEQUENTIAL NUMBERING

The transmitting unit repeats the transmission of a frame if there is no response from the receiving unit. This means that the receiving unit can receive identical frames if its response is not detected by the transmitting unit. To avoid repeated presentation of information, certain types of frame are given sequential numbers. The principle is as follows.

- The terminal sets up a sequential register for the terminal subscription MAN (up and down sequential number) and for each of the MANs stored in GROUP_LIST (only a down sequential number for each).
- A sequential number is an integer with a value in the range (0...15). The sequential numbers are incremented cyclically 1, 2, 3..., 14, 1, 2, 3 etc. The values 0 and 15 are reserved for special purposes.
- The up sequential number applies to frames transmitted in the direction from MOB to BASE. The up sequential number is increased by one by the mobile terminal for each new <MRM>-frame transmitted.
- MOB which receives a sequentially numbered frame checks the sequential number of the frame against the stored down sequential number for the corresponding MAN. If the received sequential number is the same (and not 0, see below), the information in the frame is ignored. If the sequential number is not the same (or 0, see below), the frame is accepted and the sequential number of the received frame is stored (except for 15, see below). The number is stored when acknowledgement of the frame has been sent.
- On reception, the value 0 for a sequential number means that a sequential number check should not be carried out on the frame and that the value 0 should be stored in the terminal as the new down sequential number.
- On reception, the value 15 for a sequential number means that a sequential number check should not be carried out on the frame and that the old down sequential number remains.

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The up and down sequential numbers are set to 0 when not defined (e.g. at initial start up).

Down sequential numbers for group numbers are reset to 0 when roaming in on a new base station.

Also returned packets with status UNKNOWN should have a sequential number.

When the mobile is transmitting the following types of packets, the sequential number 15 should be used:

CSUBCOM:DISCON
CONEREA
DTESERV:ACTIVE
INACTIVE
ROAM
BORN

Bidders

Express

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4.6 OUTPUT POWER CONTROL

The MOBITEX system allows for mobile terminals to control the output power via parameters in the system signalling, from the base radio station. Network operator requirements concerning this matter is stated in reference RI-06, as well as the nominal output power.

Requirements, such as the number of output levels to be controlled by the mobile terminal and in what steps the levels should be controlled, is also stated in reference RI-06.

The mobile terminal receives information about the output power to be used in the base station cell in question. This is stated by the parameter TXPOW in the <SVP>-frame.

Portable transmitters may have lower output power than ordinary transmitters. Note that the receiver sensitivity should be reduced or an offset should be added to the parameters GOOD_BASE and BAD_BASE used in the roaming procedure. This is done in order to keep the same ratio between the permitted transmission losses in the send and receive directions, i.e. to maintain a balanced radio path.

For example, if the power of the transmitter is 10 dB lower than the specified level, the receiver sensitivity could be reduced by 10 dB from the specified sensitivity level. Instead of reducing the sensitivity, an offset of 10 can be added to the parameters GOOD_BASE and BAD_BASE.

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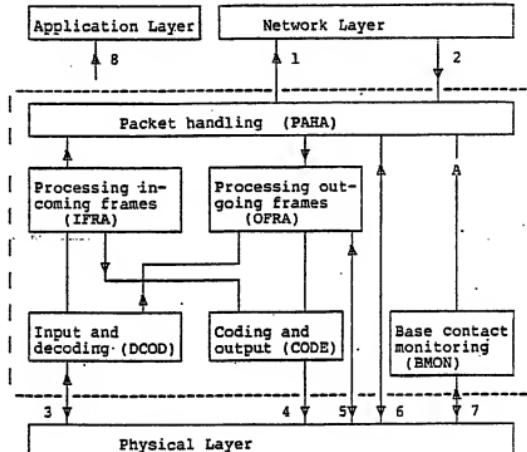
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4.7 LOGICAL DESCRIPTION

The data flow diagram below shows the interaction between modules in the Data Link Layer and between this layer and the Network and Physical Layers.



- 1- MPAK transmitted, MPAK not transmitted, MPAK received, roaming, activation
- 2- MPAK to transmit, MPAK to retransmit, speech on, speech off, order to return MPAK, list of area IDs, list of group numbers

Signals to/from Physical Layer:

- 3- Received block, Sync search
- 4- Frame to send, Frame length
- 5- Slot length, Chosen slot, Slot reached, Silence, Cannot send
- 6- Current base, Frame sent
- 7- Received base, Measure_RSSI, RSSI_measured

Signals to the Application Layer:

- 8- Speech queue info, base lost, base contact, area subscribed to chosen, area not subscribed to chosen

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4.7.1 Input and decoding (DCOD)

DCOD converts the bit stream from the physical layer into frames. It decodes the blocks of these frames and checks that the frames are addressed to the terminal.

4.7.1.1 Logical description

```

LOOP
    wait for information bits from Physical Layer
    read and decode first block
    IF first block is correct THEN
        CASE frame type
        WHEN <ACK>, <NAK>, <ATL>, <ATD>, <ATT>, <NAT> or <VKT>
            IF frame address = terminal address THEN
                send frame to OFRA
            ENDIF
        WHEN <REB>
            IF frame address = terminal address THEN
                read and decode remaining blocks of frame
                IF frame is error-free THEN
                    send frame to OFRA
                ENDIF
            ENDIF
        WHEN <PRI>, <SVP> or <TST>
            IF (frame address with mask = terminal address) OR
                (mask=0 and address = a group address) THEN
                read and decode remaining blocks of frame
                IF frame is error-free THEN
                    send frame to OFRA
                ENDIF
            ENDIF
        WHEN <AKT> or <RES>
            IF frame address = terminal address THEN
                read and decode remaining blocks of frame
                send frame to IFRA
            ENDIF
        WHEN <MRM>, <BKD>, <BKT> or <BBT>
            IF (frame address = terminal address) OR
                (frame address = a group address) THEN
                read and decode remaining blocks of frame
                send frame to IFRA
            ENDIF
        ENDCASE
    ENDIF
    send sync_search order to Physical Layer
ENDLOOP

```

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4.7.2 Processing incoming frames (IFRA)

IFRA handles the received frames from DCOD. If a received <MRM> is not error-free, IFRA requests a repeat transmission of the faulty blocks until a correct <MRM> has been received and acknowledged.

4.7.2.1 Logical description

```

LOOP
    wait for frame from DCOD
    CASE frame type
    WHEN <MRM>
        IF we have <MRM> waiting for <RES> THEN
            delete that <MRM>
        ENDIF
        IF response required THEN
            IF <MRM> is error-free THEN
                create <ACK> and send it to CODE
                send <MRM> to PAHA
            ELSE
                IF <MRM> is shorter than 3 blocks THEN
                    create <NAK> and send it to CODE
                ELSE
                    create <REB> and send it to CODE
                    store <MRM> while waiting for <RES>
                ENDIF
            ENDIF
        ELSE
            IF <MRM> is error free THEN
                send <MRM> to PAHA
            ENDIF
        ENDIF
    WHEN <RES>
        retrieve stored <MRM>
        IF sequential number = stored <MRM>:s sequential
           number THEN
            complete <MRM> with error free blocks from <RES>
            IF <MRM> is error free THEN
                create <ACK> and send it to CODE
                send <MRM> to PAHA
            ELSE
                create <REB> and send it to CODE
                store <MRM> while waiting for <RES>
            ENDIF
        ENDIF
        WHEN <ERT>, <ERD> or <ESI>
            IF frame is error free THEN
                send frame to PAHA
            ENDIF
        WHEN <AKT>
            create <ACK> and send it to CODE
        ENDCASE
    ENDLOOP

```

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4.7.3 Processing outgoing frames (OFRA)

OFRA handles the sending of frames. It must wait for permission to send, decide whether an access request is to be sent first etc.

OFRA receives <MRM>-frames of traffic types emergency, speech or data from PAHA. It returns them to PAHA with a statement of whether acknowledgement of the frame has been received or not. PAHA can also request that OFRA should cease trying to transfer the frame.

If the Data Link Layer is in speech mode, an <MRM> may be sent immediately. This is done with a timeout that is independent of any free cycles.

OFRA is capable of handling only one <MRM>-frame at a time.

4.7.3.1 Logical description.

```

LOOP
    wait for input signal
    CASE input signal
        WHEN new <MRM> from PAHA
            IF (free cycle is running) and (priority and traffic
                type allows transmission) THEN
                    choose next free slot
                    store <MRM> while waiting for slot_reached
            ELSE
                IF speech_mode THEN
                    send copy of <MRM> to CODE for transmission
                    speech_mode_timer := 2 seconds
                ELSE
                    store <MRM> while waiting for permission to send
                ENDIF
            ENDIF
            cancel_request := FALSE

        WHEN STOP_SEND from PAHA
            return <MRM> to PAHA with status 'discontinued'
            IF speech_queue THEN
                IF free_cycle is running THEN
                    choose next free slot
                ENDIF
                speech_queue := FALSE
                cancel_request := TRUE
            ENDIF

        WHEN SPEECH_TRUE from PAHA
            speech_mode := TRUE
            speech_queue := FALSE

        WHEN SPEECH_FALSE from PAHA
            speech_mode := FALSE

```

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```

WHEN timeout of speech_mode_timer
    return <MRM> to PAHA with status 'failed'

WHEN <ACK> from DCOD
    IF sequential number in <ACK> = sequential number in
        latest <MRM> THEN
            return <MRM> to PAHA with status 'OK'
            disable speech_mode_timer
        ENDIF

WHEN <NAK> from DCOD
    IF sequential number in <NAK> = sequential number in
        latest <MRM> THEN
            send copy of latest <MRM> to CODE for transmission
        ENDIF

WHEN <REB> from DCOD
    IF sequential number in <REB> = sequential number in
        latest <MRM> THEN
            create <RES> and send it to CODE for transmission
        ENDIF

WHEN <FRI> from DCOD
    update free signal parameters
    IF we have <MRM> waiting for <RES> THEN
        delete that <MRM>
    ENDIF
    IF cancel_request THEN
        choose a random free slot
    ELSE
        IF we have <MRM> to send THEN
            IF priority and traffic type allows transmission
            THEN
                IF NOT speech_queue THEN
                    IF we have already repeated <MRM> MAX REP
                        times THEN
                            return <MRM> to PAHA with status 'failed'
                        ELSE
                            choose a random free slot
                            store <MRM> while waiting for slot_reached
                        ENDIF
                    ENDIF
                ELSE
                    store <MRM> while waiting for permission to send
                ENDIF
            ENDIF
        ENDIF
    ENDIF
ENDIF

```

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Rev.	A
F.C. P.C.	MTS16.2

```

WHEN <ATD> from DCOD
  IF we have data <MRM> to send THEN
    send copy of <MRM> to CODE for transmission
  ENDIF

WHEN <ATT> from DCOD
  IF we have speech <MRM> to send THEN
    send copy of <MRM> to CODE for transmission
  ENDIF

WHEN <NAT> from DCOD
  IF we have speech <MRM> to send THEN
    IF order to leave CURRENT_BASE THEN
      return <MRM> to PAHA with status 'failed'
    ELSE
      return <MRM> to PAHA with status 'no channel'
    ENDIF
  ENDIF
  speech_queue := FALSE

WHEN <ATL> from DCOD
  IF we have emergency <MRM> to send THEN
    send copy of <MRM> to CODE for transmission
  ENDIF

WHEN <SVP> from DCOD
  IF (sub type 1 or 2) and (priority is the same as or
  less than terminal priority) THEN
    send <SVP> to PAHA
  ENDIF

WHEN <TST> from DCOD
  send signal to Physical Layer that we cannot_send in
  any slot

WHEN <VKT> from DCOD
  speech_queue := TRUE
  queue_timer := timeout value
  send Signal SPEECH_QUEUE_INFO to Application Layer

WHEN timeout of queue timer
  speech_queue := FALSE

WHEN SILENCE from Physical Layer
  send signal to Physical Layer that we cannot_send in
  any slot

```

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No. 9/1056 - A 296 5171/02 UE

Date 1990-02-26 Par P. R.

MTS16.2

```

WHEN SLOT_REACHED from Physical Layer
  IF we have <MRM> to send THEN
    CASE <MRM> traffic type
      WHEN emergency
        IF <MRM> contains more blocks than MAX_ACCESS
          THEN
            create <ABL> and send to CODE for transmission
          ELSE
            send copy of <MRM> to CODE for transmission
          ENDIF
      WHEN speech
        IF cancel_request THEN
          cancel_request := FALSE
          create <AAT> and send to CODE for transmission
        ELSE
          IF <MRM> with line connection request THEN
            IF <MRM> contains more blocks than MAX_SPEECH
              THEN
                create <ABP> and send to CODE for
                transmission
              ELSE
                send copy of <MRM> to CODE for transmission
              ENDIF
            ELSE
              send copy of <MRM> to CODE for transmission
            ENDIF
          ENDIF
      WHEN data
        IF <MRM> contains more blocks than MAX_ACCESS
          THEN
            create <ABD> and send to CODE for transmission
          ELSE
            send copy of <MRM> to CODE for transmission
          ENDIF
        ENDIF
      ENDCASE
      increment counter of attempts to send
    ENDIF
  ENDCASE
ENDLOOP

```

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Serial Date	1990-02-26	F. F. A MTS16.2

4.7.4 Coding and readout (CODE)

CODE codes the blocks of the frame and transfers the bits to the Physical Layer.

4.7.4.1 Logical description**LOOP**

Wait for frame to transmit
Code the blocks of the frame
Transfer the bits to the Physical Layer
ENDLOOP

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Reprod

A 295 51553-3

Cantel Mobitex-

No. No. 9/1056 - A 296 S171/02 Ue
Document Date 1990-02-26 Rev. A File T-16 MTS16.2

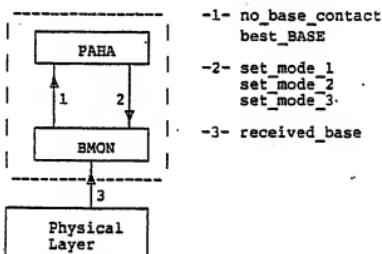
4.7.5 Base contact monitoring (BMON)

BMON monitors contact with the base station(s) and works in 3 different modes:

- 1- Normal Channel Monitoring
- 2- Quick Channel Monitoring
- 3- Disabled

For further information, see chapter ROAMING.

Input signals come from the Physical Layer and from PAHA:



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4.7.6 Packet handling (PAHA)

PAHA handles the conversion between MPAKs and <MRM>-frames. It supervises the contact with BASE and informs the network when changing BASE and when returning after lost contact with the network.

PAHA is only capable of handling one MPAK at a time and it works in three different modes:

- | | |
|------------------|---|
| Normal mode | - Contact with a base station is established and the Network Layer may send and receive all types of MPAK. |
| Speech mode | - PAHA enters this mode only on order from the Network Layer. The Network Layer also decides which MPAKs that may be sent. PAHA leaves the speech mode on order from the Network Layer or when the transmission of an <MRM> has failed. |
| Base search mode | - When base contact is lost, PAHA enters base search mode. MPAKs from the Network Layer are not handled in this mode. When a base has been located, PAHA returns to normal mode. |

The mobile terminal returns to the relevant system channel after the end of all sessions on other channels (channel_for_sending_speech, channel_for_sending_data).

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4.7.6.1 Logical description, main program

```

IF an old base is saved THEN
    send set_mode 1 to BMON
    system_channel := current_system_channel
    OFRA_status := free
    main_mode := normal_mode
ELSE
    main_mode := base_search_mode
ENDIF

LOOP
CASE main_mode
WHEN normal_mode
    normal
WHEN speech_mode
    speech
WHEN base_search_mode
    base_search
ENDCASE
ENDLOOP

```

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4.7.6.2 Logical description, normal (normal_mode)

```

WHILE main_mode = normal_mode
  wait for Input signal
CASE input signal

  WHEN MPAK TO TRANSMIT from Network Layer
    create <MRM> with new up sequential number
    IF access channel opened THEN
      change to access channel
      channel := channel_for_sending_data
    ENDIF
    send <MRM> to OPRA
    OFRA_status := busy

  WHEN MPAK TO RETRANSMIT from Network Layer
    create <MRM> with old up sequential number
    IF access channel opened THEN
      change to access channel
      channel := channel_for_sending_data
    ENDIF
    send <MRM> to OPRA
    OFRA_status := busy

  WHEN SPEECH ON from Network Layer
    main_mode := speech_mode

  WHEN RETURN MPAK from Network Layer
    send stop_send to OPRA
    wait to get frame that was in progress
    return <MRM> to Network Layer with status 'not
    transmitted'

  WHEN <SVP> from OPRA
    CASE sub type
      WHEN 1
        update parameters
      WHEN 2
        CASE type of channel
          WHEN local system channel opened
            system_channel := local
            change to new system channel
          WHEN local system channel closed
            system_channel := previous
            change to new system channel
          WHEN access channel opened
            store access channel
          WHEN access channel closed
            delete access channel
        .ENDCASE
    .ENDCASE

```

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```

WHEN <BKT> from IFRA
  IF acknowledgement of <MRM> THEN
    send <ACK> to OFRA
  ELSE
    start timer with timeout value
  ENDIF
  channel := channel_for_speech
  change to designated channel
  send set_mode_3 to BMON

WHEN <BKD> from IFRA
  IF it is a channel change to send frame THEN
    channel := channel_for_sending_data
  ELSE
    channel := channel_for_receiving_data
  ENDIF
  start timer with timeout value
  change to designated channel
  send set_mode_3 to BMON

WHEN timeout for change of channel
  change to system channel
  send set_mode_1 to BMON

WHEN <BBT> from IFRA
  store new parameters and change channel

WHEN <MRM> with status 'OK' from OFRA
  OFRA_status := free
  return MPAK to Network Layer with status 'transmitted'
  priority := normal
  IF channel = channel_for_sending_data THEN
    change to system channel
    send set_mode_1 to BMON
  ENDIF
  reset timer for change of channel

WHEN <MRM> with status 'failed' from OFRA
  OFRA_status := free
  return MPAK to Network Layer with status 'not
  transmitted'
  priority := raised
  main mode := base search mode
  reset timer for change of channel

WHEN <MRM> with status 'no channel' from OFRA
  OFRA_status := free
  return MPAK to Network Layer with status 'not
  transmitted'
  priority := raised
  reset timer for change of channel

```

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```

WHEN incoming <MRM> from IFRA
CASE incoming sequential number
WHEN 0
    check_ok := TRUE
    store new down sequential number
WHEN 15
    check_ok := TRUE
WHEN OTHERWISE
    IF different from last seq. number received THEN
        check_ok := TRUE
        store new down sequential number
    ELSE
        check_ok := FALSE
    ENDIF
ENDCASE
IF check_ok THEN
    IF channel = channel_for_receiving_data THEN
        IF response NOT required THEN
            change to system_channel
            send set_mode_1 To BMON
        ENDIF
    ENDIF
    send MPAK to Network Layer
ELSE
    delete <MRM>
ENDIF
reset timer for change of channel

WHEN Frame_sent from Physical Layer
IF frame = <ACK> THEN
    IF channel = channel_for_receiving_data THEN
        change to system_channel
        send set_mode_1 To BMON
    ENDIF
    reset timer for change of channel
ENDIF

WHEN no base_contact from BMON
IF OFRA status = busy THEN
    send stop_send to OFRA
    wait to get frame that was in progress
    return <MRM> to Network Layer with status 'not
    transmitted'
ENDIF
main_mode := base_search_mode

ENDCASE input signal

ENDWHILE

```

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4.7.6.3 Logical description, base search (base search mode)

```
wait for input signal BEST_BASE from BMON
IF roaming value > GOOD_BASE THEN
    CURRENT_BASE      := new base
    CURRENT_SYSTEM CHANNEL := new channel
    send signal ROAMING to Network Layer
    clear sequential numbers for all groups
    delete access channel
ELSE
    send signal BASE_LOST to Application Layer
    send order set_mode_2 to BMON
    REPEAT
        wait for input signal BEST_BASE from BMON
        UNTIL roaming value > CHOOSE_BASE
        IF base = CURRENT_BASE THEN
            send signal ACTIVATION to Network Layer
        ELSE
            CURRENT_BASE      := new base
            CURRENT_SYSTEM CHANNEL := new channel
            send signal ROAMING to Network Layer
            clear sequential numbers for all groups
            delete access channel
        ENDIF
        send signal BASE_CONTACT to Application Layer
    ENDIF
    send set_mode_1 to BMON
    main_mode := normal_mode
```

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4.7.6.4 Logical description, speech (speech mode)

```

send speech_true to OFRA
WHILE main_mode = speech_mode
CASE input signal
WHEN speech_off from Network Layer
    wait 0.5 seconds
    change to system_channel
    send set_mode 1 to BMON
    send speech_false to OFRA
    main_mode := normal_mode

WHEN new MPAK from Network Layer
    create <MRM> with new up sequential number
    send <MRM> to OFRA
    OFRA_status := busy

WHEN MPAK from Network Layer to be retransmitted
    create <MRM> with old up sequential number
    send <MRM> to OFRA
    OFRA_status := busy

WHEN <MRM> with status 'OK' from OFRA
    OFRA_status := free
    IF <MRM> with CSUBCOM:DISCON THEN
        change to system channel
        send set_mode 1 to BMON
        send speech_false to OFRA
        main_mode := normal_mode
    ENDIF
    return MPAK to Network Layer with status 'transmitted'

WHEN <MRM> with status 'failed' from OFRA
    change to system_channel
    send set_mode 1 to BMON
    send speech_false to OFRA
    main_mode := normal_mode
    IF <MRM> with CSUBCOM:DISCON THEN
        send <MRM> to OFRA
    ELSE
        OFRA_status := free
        return MPAK to Network Layer with status 'not
        transmitted'
    ENDIF

WHEN <BBT> from IFRA
    store new parameters and change channel

```

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Replay

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```
WHEN incoming <MRM> from IFRA
CASE incoming sequential number
WHEN 0
    send MPAK to Network Layer
    store new down sequential number
WHEN 15
    send MPAK to Network Layer
WHEN OTHERWISE
    IF different from last seq. number received THEN
        send MPAK to Network Layer
        store new down sequential number
    ELSE
        delete <MRM>
    ENDIF
ENDCASE

WHEN signal from BMON
ignore this signal
ENDCASE

ENDWHILE
```

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Report

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4.8 TRANSFER EXAMPLES

This chapter describes the most common transfer cases of the protocol.

4.8.1 Transfer without response

Transfer without response can only take place in the direction BASE to MOB.

In traffic to mobile terminal(s) BASE often addresses more than one MOB. This can apply to traffic to group numbers or frames where masked addressing occurs. In these cases MOB will not transmit a response. BASE states this by not setting the response flag in these frames.

Ex 1:1

Transfer without response, <MRM> BASE --> MOB

BASE <MRM>
MOB

-----> t

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4.8.2 Transfer with simple acknowledgement

BASE has full control over the down frequency and can transmit an <MRM>-frame at any time to a certain MOB. If the response flag is set and no incorrigible bit error has been detected in the frame, MOB should reply with <ACK>.

Ex 2.1

Transfer with response, <MRM> BASE --> MOB

BASE	<MRM>
MOB	<ACK>

>t

Note that <ACK> is sent without considering slot boundaries and other access limitations.

Ex 2.2

Transfer with response, <FRI> MOB ---> BASE

BASE	<FRI>	<ACK>
MOB	<MRM>	

>t

By transmitting <FRI>, BASE allows MOB to transmit <MRM>.

In this case MOB expects an acknowledgement from BASE. The lack of an acknowledgement is indicated in this case by MOB receiving a <FRI> without having previously received acknowledgement of its frame. Frame repetition follows in this case.

Free slots is defined, and thus access permission to the up channel is granted, when BASE transmits a <FRI> with an address that is applicable to MOB. Access permission is withdrawn for a certain MOB if any of the following cases arise.

- 1 BASE transmits a silence signal (see reference RI-17). This signal applies to all terminals.
- 2 BASE transmits a <TST> with an address which applies to MOB.
- 3 The free-cycle period as defined in the <FRI>-signal expires.

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4.8.3 Transfer with block repetition

If the receiver of an <MRM> detects that one or more of the following blocks is incorrigible, the receiver may request repetition of these blocks with a <REB>. The sender replies with a <RES>.

NOTE Block repetition occurs only on <MRM>-frames where the number of blocks is 3 or more.

EX 3.1

Transfer with block repeat, MOB ---> BASE

BASE <REB> <ACK>
MOB <MRM> <RES>

-----> t

The principle described in the figure above applies in the direction to BASE and in the direction to MOB.

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4.8.4 Transfer with frame repetition

Frame repetition can occur for three reasons:

- 1 The receiving unit transmits a <NAK>
- 2 The receiving unit does not transmit a response
- 3 The packet type results in frame repetition

Ex 4.1

Transfer with negative acknowledgement MOB ---> BASE

BASE	< MRM >	<MRM>	
MOB	"	<NAK>	<ACK>

-----> t

If the receiving unit finds that the received frame is incorrectable and is less than 3 blocks, it can notify the sender unit by transmitting a <NAK>. The transmitting unit should then repeat the message. The principle above applies in both transmission directions.

The frame is repeated immediately after an <NAK> is received, regardless of slot boundaries.

Ex 4.2

Transfer with frame repeat, MOB ---> BASE

BASE	<FR1>	<ACK>	<FR1>	<ACK>
MOB	<MRM>	<MRM>	<MRM>	

XXXXX-----> t

In this example the first acknowledgement from BASE is destroyed by interference so that MOB retransmits the same message after the next free signal.

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Ex 4.3

Transfer with frame repeat, BASE ---> MOB

BASE < MRM >	<MRM>
MOB	-----> t

In this example, frame repeat is caused by the packet type demanding repeated transmission. The response flag is never set in this case.

This case occurs for MPAK to group numbers. To avoid repeated presentation of the information in the frame, the frame has got a sequential number. According to the principles for sequential numbering, MOB will ignore subsequent identical frames.

NOTE! At the restart of a base radio station, the sequential numbers for all groups are set to 0. This is done to ensure that mobiles will not loose the first message to a group. The consequence of this action will be that the first message may be presented MAX_REP + 1 times at the mobile terminal.

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4.8.5 Transfer with access request

If an <MRM>-frame to be sent from MOB to BASE is longer than MAX_ACCESS this <MRM> may not be sent during free slots. These longer frames are handled with access request, <ABD>, and access permission, <ATD>.

EX 5.1

Transfer with access request, MOB ---> BASE

BASE	<PRI>	<ATD>	<ACK>
MOB	<ABD>	<MRM>	

-----> t

The principle is that instead of MOB transmitting its <MRM>-frame, it transmits an <ABD>-frame. The reply to this request is an access permission, <ATD>. When MOB receives access permission, it immediately starts transmitting the <MRM>.

EX 5.2

Repetition with max_rep, MOB ---> BASE

BASE	<PRI>	..<PRI><PRI>	
MOB	<ABD>	<ABD>	<ABD>	t1

-----> t

- t1: When the number of transmitted access requests is equal to MAX REP+1 and another <PRI> is received, the MPDU is returned to the network layer and a new base is chosen.

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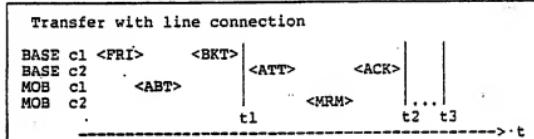
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4.8.6 Transfer with line connection

The line connection session is described in reference R1-09. When MOB wants to send an <MRM> (containing a request for a line connection) longer than MAX SPEECH it must request access for this. The access request results in a channel change order. On the new channel the session for frames takes place to establish the line connection. When the line connection is concluded MOB returns to the system channel.

EX 6.1

- t1: Disable roaming and start timeout with time from <BKT>.
- t2: Stop timeout.
- t3: Speech_on received from Network Layer.

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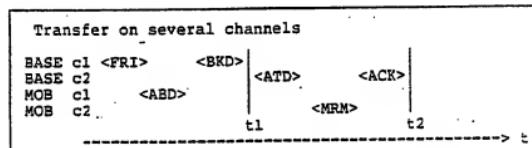
S/N	9/1056 - A 296 5171/02 Ue
Date	1990-02-26
Time	13:00
F/F	MTS16.2

4.8.7 Transfer on several channels

Transfer on several channels can be divided into two separate cases:

- 1 MOB appears on another channel because BASE has stated in a <SVP>-frame that all traffic from a mobile terminal shall be sent on a channel other than that on which the <SVP> came.
- 2 BASE transmits a <BKD>-frame as a reply to an <ABD>.

EX 7.1



t1: Disable roaming and start timeout with time from <BKD>.

t2: Return to system_channel, enable roaming.

In this example, the access request from MOB resulted in a channel change order. The access permission is transmitted on channel c2. After having received an acknowledgement, MOB returns to channel c1.

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4.8.8 Line connection with hand over**EX 8.1****Ordinary line connection**

BASE1,c1	<FR>	<BKT>		
BASE1,c2		<ATT>	<ACK>	... speech
MOB, c1		<ABT>		
MOB, c2			CONREQ	... speech
				t1
				----->t

t1: Ordinary connection established.

EX 8.2**Continued with <BBT>**

BASE2,c1					... speech .		<ACK>
BASE2,c3								
BASE1,c1								
BASE1,c2	<BBT>					
MOB, c1								
MOB, c2							
MOB, c3					.. speech .	DISCON		
					t2	t3	t4	t5
								----->t

t2: Hand over to base B2.

t3: MOB connected to base B2 on new speech channel, new system channel stored for later use.

t4: MOB breaks connection and changes to the new system channel.

t5: Connection ended.

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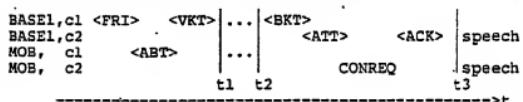
9/1056	A 296	5171/02 Ue
1990-02-26	A	MTS16.2

4.8.9 Line connection with queue handling.

If no speech channel is immediately available, BASE may place MOB in a queue of callers and reply with <VKT>.

EX 9.1

Successfully established line connection

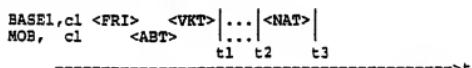


t1-t2: Waiting time.

t3: Connection established.

EX 9.2

Call attempt ended by BASE

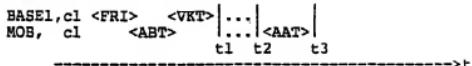


t1-t2: Waiting time.

t3: Call attempt ended.

EX 9.3

Call attempt ended by MOB



t1-t2: Waiting time.

t3: Call attempt ended.

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1990-02-26 A MTS16.2

EX 9.4

Call attempt ended by MOB

BASEL,cl <FR>	<VKT>	...	<VKT>	...	<AAAT>		
MOB,	cl	<ABT>	t1	t2	t3	t4	t5
----->t							

t1-t2: Waiting time.

t3-t4: Waiting time.

t5: Call attempt ended.

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4.8.10 Line connection without access request

When MOB wants to send an <MRM> (containing a request for a line connection) shorter than or equal to MAX_SPEECH no access request is needed.

The response to the <MRM> is a channel change order that includes an acknowledgement. The line connection is immediately established on the new channel.

EX 10.1

Line connection without access request

```
BASE c1 <FR1>      <BKT>
BASE c2          .. speech ..
MOB  c1      <MRM>
MOB  c2          .. speech ..
```

>t

4.8.11 Ending a line connection

An <MRM> with a DISCON may be transmitted only once on the speech channel. If MOB have not received <ACK> within 2 seconds, it changes to the system channel and continues the transmission attempts according to the usual rules.

EX 11.1

Ending a line connection

BASE c1	<FR1>	<ACK>
BASE c2 ..speech.....		
MOB c1	DISCON	.
MOB c2 ..speech..		

t1 t2 t3

>t

t1-t2: Timeout.

t2: Return to system channel, enable roaming.

t3: Connection ended.

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Replies

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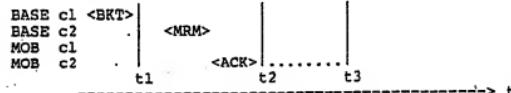
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4.8.12 Line connection ended by speech off

After the mobile terminal has received an <MRM> containing a line connection request, the session may be put to an end by the signal speech_off from the network layer. This signal is generated by a timeout (please see reference R1-09) when the operator has not answered the call.

EX 12.1

Connection ended by signal speech_off



- t1: Disable roaming and start timeout with time from <BKT>.
- t2: Stop timeout.
- t3: Speech_off received from Network Layer. Return to system channel and enable roaming.

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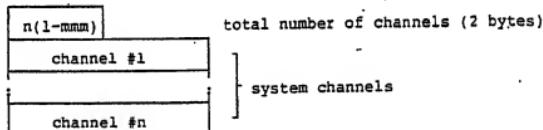
5 SYSTEM PARAMETERS TO BE STORED IN THE TERMINAL

Certain system parameters are stored continuously (even if the terminal is powered off) in MOB to permit correct action when starting up. These are:

- The terminal subscription MAN
 - Group number list (GROUP LIST)
 - Maximum number of retransmissions allowed (MAX REP)
 - Sequential numbers - terminal MAN (up/down)
 - Current base
 - Current system channel
 - A list of the area identifications that the mobile is allowed to use. Please see reference R1-06.

When switched on, all these parameters apply until a frame is received containing the current parameter values.

There is also a permanent (and possibly a temporary) default list of system channels used by the roaming algorithm. They are stored continuously and have the following general format:



A channel is defined as a pair of frequencies and all the channels of this list are given in reference R1-06.

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6 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RL-06, 17, 22, 31, 62
 RL-09, 4, 7, 55, 61
 RL-17, 5, 14, 17, 24, 50

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RL-01	Arrangement of the documents
RL-02	MOBITEX System description
RL-03	General description of terminals
RL-04	Terminology
RL-05	References
RL-06	Network operator information
RL-08	Application layer
RL-09	Network layer
RL-11	Interface requirements, fixed terminals
RL-12	Other requirements, fixed terminals
RL-16	Link layer, mobile terminals
RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

Subject:

Reason:

A 296 5171/02

REQUIREMENT SPECIFICATION

Ed. Sheet
1 (44)

Prepared - ET/SYS IK	Facsimile/Email - Subject response ET/SYS IK	No. No 91/1056 - A 296 5171/A2 Ue	
Reviewed/checked - Doc responsible approved ET/SYS IK		Date Issued 1990-02-22	1 Rev Fic File MTS16A.2
Beginning		Tech MOBITEX Data Link Layer, Mobile Terminal Appendix A, Frames, 8/16 kbps	
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ABSTRACT

This document describes frame structure and coding for the
Data Link Layer.

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1. INTRODUCTION

1.1 GENERAL

The mobile terminal's Data Link Layer together with the Physical Layer form a radio protocol for communication between mobile stations (MOB) and a base radio station (BASE).

The interchange of information between BASE and MOB is in the form of frames. There are 21 different types of frames.

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2 FRAME TYPES

There are 21 different frame types:

	Name	Designation	Transmitted by	BASE	MOB
1	M frame	<MRM>	Yes	Yes	
2	Acknowledgement	<ACK>	Yes	Yes	
3	Negative acknowledgement	<NAK>	Yes	Yes	
4	Repetition request	<REQ>	Yes	Yes	
5	Repetition reply	<RES>	Yes	Yes	
6	Access request, data	<ABD>	No	Yes	
7	Access request, speech	<ABT>	No	Yes	
8	Access request, emergency	<ABL>	No	Yes	
9	Access permission, data	<ATD>	Yes	No	
10	Access permission, speech	<ATT>	Yes	No	
11	Access permission, emergency	<ATL>	Yes	No	
12	Change channel, data	<BDI>	Yes	No	
13	Change channel, speech	<BTI>	Yes	No	
14	Free signal	<FRI>	Yes	No	
15	Sweep signal	<SVP>	Yes	No	
16	Silence order	<TST>	Yes	No	
17	Activity request	<ART>	Yes	No	
18	No access permission, speech	<NAT>	Yes	No	
19	Change base station, speech	<BBT>	Yes	No	
20	Wait for channel,speech	<VRT>	Yes	No	
21	Cancel access request, speech	<AAT>	No	Yes	

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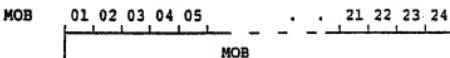
3 DESCRIPTION OF GENERAL FIELDS

In this chapter the general fields of a frame are described. Fields occurring only in specific frame types are described in conjunction with the definition of the respective frame type.

The fields are described in the following order:

1	MOB	address of mobile terminal, or group
2	TYPE	type of frame
3	BLOCK	number of blocks in the frame
4	PARTY	check sum
5	MASK	for masked addressing
6	PRIOR	for priority addressing
7a	UPFREQ	frequency number, up frequency
7b	DOFREQ	frequency number, down frequency
8	NUMRET	number of retransmissions

The most significant bit lies to the left in the field, has the lowest order number and is sent and received first in time.



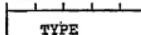
MOB states the address of the mobile unit concerned. This address refers to the terminals own subscription number, or to any number representing a group to which the terminal belongs.

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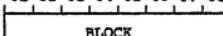
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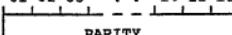
TYPE 01 02 03 04 05


TYPE is bit 28-32 of the primary block and indicates the type of frame according to the following table:

Decimal	Value	Type designation
	Binary	
01	00001	<NRM>
02	00010	<ACK>
03	00011	<NAK>
04	00100	<REB>
05	00101	<RES>
06	00110	<ABD>
07	00111	<ABT>
08	01000	<ABL>
09	01001	<ATD>
-10	01010	<ATT>
11	01011	<ATL>
12	01100	<BKD>
13	01101	<BRK>
14	01110	<FR1>
15	01111	<SVR>
16	10000	<TST>
17	10001	<AKT>
18	10010	<NAT>
19	10011	<BBT>
20	10100	<VKT>
21	10101	<AAT>

BLOCK 01 02 03 04 05 06 07 08


States the number of blocks in the frame, including primary block.

PARITY 01 02 03 . . 14 15 16


A frame comprises one or more blocks. A block comprises a source word and a coded parity word.

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MASK 01 02 03 04 05

MASK

A group of terminals is addressed with masked addressing. The MASK states the number of most significant bits of the MOB address that should be ignored.

PRIO 01 02 03

PRIO

PRIO	Meaning
7 111	Priority group 4, raised priority
6 110	" , normal
5 101	Priority group 3, raised priority
4 100	" , normal
3 011	Priority group 2, raised priority
2 010	" , normal
1 001	Priority group 1, raised priority
0 000	" , normal

UPFREQ 01 02 03 04 . . . 12 13 14 15 16

UPFREQ

|<-FBI-->|----- FREQ. NO. -----|

DOFREQ 01 02 03 . . . 12 13 14 15 16

DOFREQ

States the frequency number, UPFREQ for transmit frequency and DOFREQ for receive frequency.

Bit 1 to 3 gives FBI (frequency band and bit rate INFORMATION) and bit 4 to 16 gives the frequency number. Both the parameters are defined in reference RI-06.

NUMRET 01 02 03 04 05 06 07 08

NUMRET

States the number of retransmissions, including the current try.

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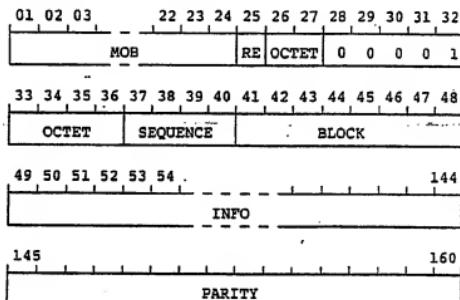
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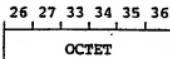
4 FRAME TYPE DESCRIPTIONS

4.1 FRAME TYPE <MRM>, M-frame

APPLICATION An <MRM> is used to transfer packets. The packet format is defined in reference R1-09.

PRIMARY BLOCK

OCTET States the number of valid octets in the last following block. Remaining octets of the last block are filled with "0" to give a complete block. The field contains 6 bits and is used in the following way:



SEQUENCE States the sequential number of the frame.

RE States whether a response is to be given to the frame. The mobile terminal shall always set this flag to "1" on transmission.

INFO Contains 12 octets of source data from the packet.

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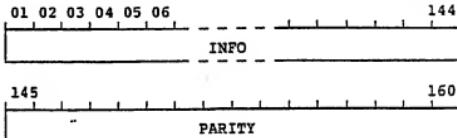
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Date	1990-02-22	Rev
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FOLLOWING BLOCK**APPLICATION**

The packet is placed in the following blocks with 18 octets from the packet in each. The number of valid octets in the last following block is indicated in the OCTET field of the primary block. The last following block is filled with "0" in the octets which do not belong to the packet.



INFO Contains 18 octets of source data from the packet.

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1990-02-22 A MTS16A.2

4.2 FRAME TYPE <ACK>, Acknowledgement

APPLICATION An **<ACK>** acknowledges a correctly received frame.

<ACK> indicates that all blocks in the frame have been correctly received. It includes the sequential number of the received frame.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32		
			MOB		0	0	0	0	0	0	1	0			
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0	0	0	0	SEQUENCE			BLOCK								
49	50	51	52	53	54										144
0	0	0	0	0	0	- - -	- - -	- - -	- - -	- - -	0	0	0	0	0
145															160
PARITY															

SEQUENCE States the sequential number of the corresponding <MRM>-frame.

FOLLOWING BLOCK

No following blocks in this type of frame.

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No. 91/1056 - A 296 5171/A2 Ue

Datum: 02-22 | Rev. 1 | Pg. 1 of 2 MTS16A.2

4.3 FRAME TYPE <NAK>, Negative acknowledgement

APPLICATION A <NAK> requests repetition of the entire <MRM>.

<NAK> indicates that the primary block has been correctly received, but that the following blocks have been lost. It contains the sequential number of the received primary block. <NAK> results in a complete repetition of the lost <MRM>.

Note that if the number of blocks in <MRM> was 3 or more, <REB> is used instead of <NAK>.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	0	0	0	1	1
33	34	35	36	37	38	39	40	41	42	43	44	45	46
0	0	0	0	SEQUENCE				BLOCK					
49	50	51	52	53	54								144
0	0	0	0	0	0								0
145													160

SEQUENCE

States the sequential number of the corresponding <MRM>-frame.

FOLLOWING BLOCK

No following blocks in this type of frame.

Blockstart

Replay

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No	91/1056	- A 296	5171/A2 Ue
Date	1990-02-22	1 Rev	Fl./File MTS16A.2

4.4 FRAME TYPE <REB>, Repetition request

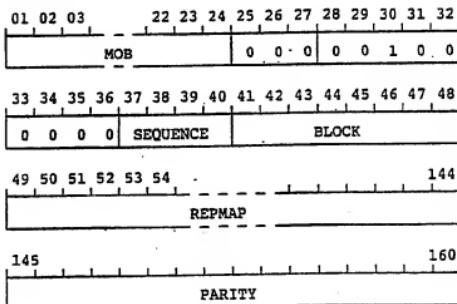
APPLICATION A <REB> requests repetition of erroneous blocks in an <MRM>.

If it is found during reception that certain blocks in a frame cannot be corrected, a request for these blocks to be repeated can be made by transmitting a <REB>. The request contains a bit map of the blocks to be repeated. This bit map refers to the original <MRM>, even during a sequence of repetitions.

<REB> contains the sequential number of the received <MRM> primary block and results in a <RES>.

Note that if the number of blocks in <MRM> was 2 or less, <NAK> is used instead of <REB>.

PRIMARY BLOCK



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Series Date	1990-02-22	F. F. A MTS16A.2
SEQUENCE		States the sequential number of the corresponding <MRM>-frame.
REPMAP		Contains a bit map where each bit represents a block in the <MRM> previously received. A bit set to "1" indicates that the corresponding block is to be repeated. The bit in a REPMAP representing the primary block shall always have the value "0", since repetition of the primary block is illegal.
FOLLOWING BLOCK		No following blocks in this type of frame.
<hr/> <hr/> <hr/>		
<input type="checkbox"/> Standard <input type="checkbox"/> Proprietary <input type="checkbox"/> Reserved		
<input type="checkbox"/> Proprietary <input type="checkbox"/> Reserved <input type="checkbox"/>		

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4.5 FRAME TYPE <RES>, Repetition reply

APPLICATION A <RES> is the reply to a <REB>.

<RES> is a selective repetition of blocks from an <MRM>. The following blocks of the <RES> contain copies of blocks according to the bit map of the <REB>. <RES> contains the sequential number of the original <MRM>.

PRIMARY BLOCK

SEQUENCE States the sequential number of the corresponding <MRM>-frame.

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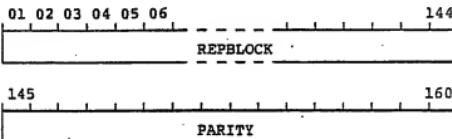
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Nr. No.	91/1056 - A 296	5171/A2 Ue
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FOLLOWING BLOCK**APPLICATION**

The following blocks contain copies of blocks according to the bit map of the <REB>. Only blocks requested to be repeated shall be packed into the following blocks. The order of the blocks is that stated in REPMAP.



REPBLOCK The copy of a block from the original <MRM>-frame.

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Ref. No.	91/1056	1 Rev.	A 296 5171/A2 Ue
Date	1990-02-22	A	MTS16A.2

4.6 FRAME TYPE <ABD>, Access request, data.

APPLICATION An <ABD> is a request to transmit an <MRM> whose length (number of blocks) exceeds the value of MAX ACCESS.

If the length of the <MRM> exceeds MAX ACCESS, access must be requested before the <MRM> may be sent.

The <ABD> states the number of blocks in the corresponding <MRM>.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
MOB									0	0	0	1	1

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
BLOCK N								BLOCK							

49	50	51	52	53	54	55	56	57	144			
NUMRET								0	0	0	0	0

145	160
PARITY	

BLOCK N States the number of blocks for which access is requested.

FOLLOWING BLOCK No following blocks in this type of frame.

Blocks

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91/1056 - A 296 5171/A2 Ue

Datum Date 1990-02-22 Type A File MTS16A.2

4.7 FRAME TYPE <ABT>, Access request, speech

APPLICATION An <ABT> is a request to transmit an <MRM> containing a request for a line connection, whose length (number of blocks) exceeds the value of MAX_SPEECH.

The <ABT> states the number of blocks in the corresponding <MRM>.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	0	1	1	1	

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
BLOCK N								BLOCK							

49	50	51	52	53	54	55	56	57								144
NUMRET								0								

145																160
PARITY																

BLOCK N States the number of blocks for which access is requested.

FOLLOWING BLOCK No following blocks in this type of frame.

Systech

Systech

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Nr. Nr.	91/1056	A 296	5171/A2 Ue
Serial Date	1990-02-22	Rev	PC FDDI
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4.8 FRAME TYPE <ABL>, Access request, emergency.

APPLICATION An <ABL> is a request to transmit an <MRM> containing an emergency signal whose length exceeds the value of MAX_ACCESS.

If the length of the <MRM> exceeds MAX_ACCESS, access must be requested before the <MRM> may be sent.

The <ABL> states the number of blocks in the corresponding <MRM>.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB		0	0	0	0	1	0	0	0	0
33	34	35	36	37	38	39	40	41	42	43	44	45	46
													47
48													
BLOCK N													
49	50	51	52	53	54	55	56	57					144
NUMRET									0			0	0
145													160
PARITY													

BLOCK N States the number of blocks for which access is requested.

FOLLOWING BLOCK No following blocks in this type of frame.

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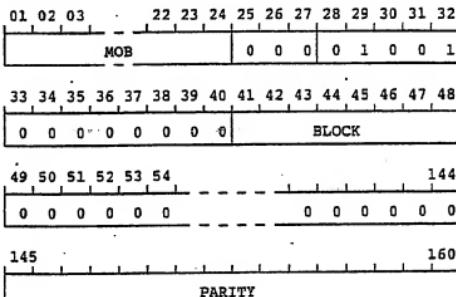
91/1056 - A 296 S171/A2 Ue
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 1990-02-22 A PC File
 MTS16A.2

4.9 FRAME TYPE <ATD>, Access permission, data.

APPLICATION BASE replies with an <ATD> to an <ABD> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted, MOB is expected to transmit an <MRM> containing a data packet.

PRIMARY BLOCK



FOLLOWING BLOCK

No following blocks in this type of frame.

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4.10 FRAME TYPE <ATT>, Access permission, speech.

APPLICATION BASE replies with an <ATT> to an <ABT> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted, MOB is expected to transmit an <MRM> containing a request for line connection.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	0	1	0	1	0
33	34	35	36	37	38	39	40	41	42	43	44	45	46
0	0	0	0	0	0	0	0			BLOCK			
49	50	51	52	53	54								144
0	0	0	0	0	0					0	0	0	0
145													160
										PARITY			

FOLLOWING BLOCK

No following blocks in this type of frame.

Blankert

Reprod

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Serial Date	1990-02-22	Rev A

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4.11 FRAME TYPE <ATL>, Access permission, emergency.

APPLICATION BASE replies with an <ATL> to an <ABL> from a MOB, when BASE is ready to accept an <MRM>.

When permission is granted, MOB is expected to transmit an <MRM> containing an emergency signal.

PRIMARY BLOCK

01	02	03	-	22	23	24	25	26	27	28	29	30	31	32
				MOB			0	0	0	0	1	0	1	1
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	50	51	52	53	54									144
0	0	0	0	0	0	0						0	0	0
145														160

FOLLOWING BLOCK

No following blocks in this type of frame.

Stdukt:

Repros

A-22 51533

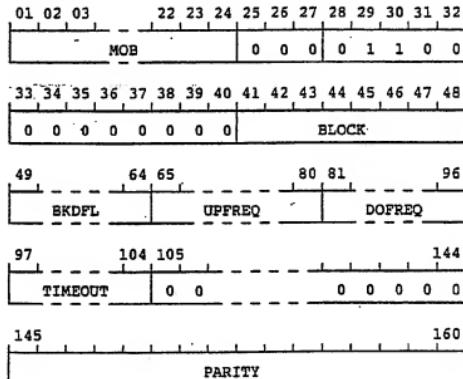
Cantel Mobitex -

No.	No.	91/1056	- A 296	5171/A2 Ue
Series	Date	1990-02-22	Rev.	Ver. Rev.
		A		MTS16A.2

4.12 FRAME TYPE <BKD>, Change channel, data:

APPLICATION A <BKD> orders a MOB to another channel in order to transmit or receive an <MRM>.

The MOB usually returns to the original channel when the <MRM> has been transmitted or received. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKD>.

PRIMARY BLOCK

Bildkort

Reprod

A 292 5155-2

Cantel Mobitex-		No. No 91/1056 - A 296 5171/A2 Ue	Date 1990-02-22	I Rev A	F. P. R. MTS16A.2
BRDFL Indicates how the terminal is to act on the new channel.					
Bit 1 Reserved					
2 Reserved					
3 Reserved					
4 Change to send <MRM>					
5 Change to receive <MRM>					
6..16 Reserved					
UPFREQ Frequency number for up frequency, i.e. the frequency on which the terminal transmits.					
DOFREQ Frequency number of down frequency, i.e. the frequency on which BASE transmits.					
TIMEOUT If error, return after TIMEOUT seconds (1-255).					
FOLLOWING BLOCK No following blocks in this type of frame.					
<input type="checkbox"/> Bildkort <input type="checkbox"/> <input type="checkbox"/> Tapron					

Cantel Mobitex

Mr No	91/1056	- A 296	5171/A2 Ue
Source Date	1990-02-22	Ver	MTS16A.2

4.13 FRAME TYPE <BKT>, Change channel, speech.

APPLICATION A <BKT> orders a MOB to another channel in order to transmit or receive an <MRM> containing a request for line connection.

Normally the terminal returns to the original channel when the line connection is over. If an error occurs on the assigned channel then MOB returns to the original channel after a timeout period stated in the <BKT>.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	0	1	1	0	1
33	34	35	36	37	38	39	40	41	42	43	44	45	46
0	0	0	0	SEQUENCE						BLOCK			47
49			64	65		80	81						96
			BRTFL		UPFREQ					DOFREQ			
97			104	105									144
			TIMEOUT		0	0				0	0	0	0
145													160
										PARITY			

Biliken:

Reorder

Cantel Mobitex

Nr. Nr.	91/1056 - A 296	5171/A2 Ue
Datum/Ort	1990-02-22 A	MTS16A.2

SEQUENCE Only valid if BKTPFL bit 6 is TRUE.

BKTPFL Indicates how the terminal is to act on the new channel.

Bit 1	Reserved
2	Reserved
3	Reserved
4	Change to send <MRM>
5	Change to receive <MRM>
6	Acknowledgement. (including sequence number) of correctly received speech <MRM>. Ignore timeout.
7..16	Reserved

UPFREQ Frequency number for up frequency, i.e. the frequency on which the terminal transmits.

DOPREQ Frequency number of down frequency, i.e. the frequency on which BASE transmits.

TIMEOUT If error, return after TIMEOUT seconds (1-255).

FOLLOWING BLOCK No following blocks in this type of frame.

Söderort

Reproduk

A 296 5171/A2

Cantel Mobicex

91/1056 - A 296 5171/A2 Ue
1990-02-22 A MTS16A.2

4.14 FRAME TYPE <FR1>, Free signal.

APPLICATION BASE transmits a <FR1> when it is ready to handle traffic from MOB.

A free signal precedes a free cycle. A free cycle is a period of time when all of, or parts of, the total fleet of mobile terminals are collectively permitted to transmit.

PRIMARY BLOCK

Ridgeley

200

Cantel Mobitex-

No.	91/1056	- A 296	5171/A2 Ue
Date - Date	1990-02-22	Rev	FC F1A MTS16A.2

FFG The FFG field states the type of traffic to which the free signal applies according to the following table.

Value	Emergency	Speech	Data
00	yes	no	no
01	yes	no	yes
10	yes	yes	no
11	yes	yes	yes

RAND_SLOTS The maximum number of the random number generator which selects in which slot the transmission shall start.

FREE_SLOTS The number of free slots in this free cycle.

MAX_ACCESS States the number of blocks which may be sent in an <MRM> without being preceded by an access request.

SLOT_LENGTH Current value of slot_length.

MAX_SPEECH States the number of blocks which may be sent in a line connection request without being preceded by an access request.

FOLLOWING_BLOCK No following blocks in this type of frame.

Bildkurs

Reprod.

Cantel Mobitex-

Sr No	91/1056 - A 296	5171/A2 Ue
Design Date	1990-02-22	A MTS16A.2

4.15 FRAME TYPE <SVP>, Sweep signal**APPLICATION**

The sweep signal is a periodically recurring signal from BASE. An <SVP> is transmitted by BASE for two reasons:

1 <SVP> marks the start of a sweep cycle.

2 <SVP> contains system parameters.

<SVP> has 2 different subtypes:

1 states the values of system parameters

2 states the frequency of different channel types

Bildnr:

Reprod:

Cantel Mobitex

St. Nr.	91/1056	- A 296	5171/A2 Ue
Date	1990-02-22	Rev.	F1, P1
			MTS16A.2

<SVP>, SUBTYPE 1 - states the values of system parameters.

PRIMARY BLOCK

01 02 03	22 23 24 25 26 27 28 29 30 31 32
MOB	0 0 0 0 1 1 1 1

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48	BLOCK
PRIOR	MASK

49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64	TXPOW
SVPTYP	

65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80	RSSI_PERIOD
RSSI_PROC	

81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96	MAX REP
TIME_TO_NEXT	

97	104 105	112
BASEST	SCAN_TIME	

113	120 121	128
BAD_BASE	GOOD_BASE	

129	136 137	144
BETTER_BASE	0 0 0 0 0 0 0 0	

145	160
PARITY	

Bildkort

Zugriff

Cantel Mobitex-

No. 91/1056 - A 296 S171/A2 Ue

Date: 1990-02-22 | Rev: A | PL: MTS16A.2

SVPTYP	States the <SVP> subtype, value 00000001 in this case.
TXPOW	States the decrease in output power (0-255 dB below nominal level) to be used by the mobile. A default value of 0 is used until this signal is received.
RSSI_PROC	States the method of the signal strength measurement: 0 = FRAME 1 = CONTINUOUS The default value is FRAME.
RSSI_PERIOD	Time used by the roaming algorithm (0-255 *20 ms). Default value: 148 (2 960 ms).
TIME_TO_NEXT	States the time in seconds to the next <SVP> frame. Default value: 10.
MAX REP	States the value of the variable Max_rep.
BASEST	States status of base station.
SCAN_TIME	States the length of a period (0-255 *100 ms) when the terminal scans other system channels. Default value: 30 (3 seconds).
BAD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
GOOD_BASE	Used by the roaming algorithm. 0-255 dBuV. Default value: 15.
BETTER_BASE	Used by the roaming algorithm. 0-255 dB. Default value: 10.

Most of the parameters above are further described in the MAIN DOCUMENT.

Bildkort

Reprod

Cantel Mobitex

No. No 91/1056 - A 296 5171/A2 Ue

Format Date 1990-02-22 | Rev A | F. F.4 MTS16A.2

FOLLOWING BLOCKS

If any, they contain a list of system channels to be used in base station monitoring. A frame with a list containing new system channels completely overrides the previous frame. The channel list has the following format (as described in the MAIN DOCUMENT):

FOLLOWING BLOCK #1

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
number of channels															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17										32	33				48
channel #1 - UPFREQ								channel #1 - DOFREQ							
49										64	65				80
channel #2 - UPFREQ								channel #2 - DOFREQ							
81										96	97				112
channel #3 - UPFREQ								channel #3 - DOFREQ							
113										128	129				144
channel #4 - UPFREQ								channel #4 - DOFREQ							
145															160
PARITY															

The number of following blocks depends on the size of the list. The maximum number of channels in the list is stated in reference R1-06.

Continues with following block #2 on the next page.

Bildkort

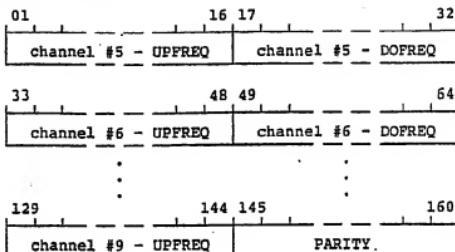
Reprint

A3925155-3

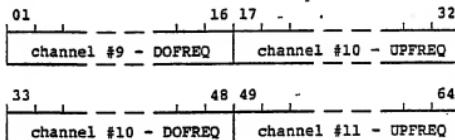
Cantel Mobitex

Ref. No. 91/1056 - A 296 S171/A2 Ue
Date 1990-02-22 Rev. A FC Fis MTS16A.2

FOLLOWING BLOCK #2



FOLLOWING BLOCK #3



etc.

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A 296 S171/A2

Cantel Mobitex

Ver-Nr	91/1056	A 296	5171/A2 Ue
Datei-Dat	1990-02-22	Rev	PL-Fd
		A	MTS15A.2

<SVP>, SUBTYPE 2

- states the frequency of
different channel types.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB		0	0	0	0	1	1	1	1	
33	34	35	36	37	38	39	40	41	42	43	44	45	46
PRIOR		MASK			BLOCK								47
49	50	51	52	53	54	55	56	57	58	59	60	61	62
	SVPTYP									CHATYP			63
64													
65	66	67	68	69	70	71	72	73	74	75	76	77	78
													79
													80
UPFREQ													
81	82	83	84	85	86	87	88	89	90	91	92	93	94
													95
													96
DOFREQ													
97	98	99	100										144
0	0	0	0	0	0	0							
145													160
PARITY													

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Report

A 295 S155/3

Cantel Mobitex		Nr. No 91/1056 - A 296 5171/A2 Ue
		Date / Date Rev File 1990-02-22 A MTS16A.2
SVPTYP States the <SVP> subtype, value 00000010 in this case.		
CHTYP States the type of channel: <u>Value:</u>		
1 Local system channel opened 2 Not used (ignore that order) 3 Local system channel closed (return to national system channel) 4 Access channel opened 5 Access channel closed		
UPFREQ Frequency number for up frequency, i.e. the frequency on which the terminal transmits.		
DOPFREQ Frequency number for down frequency, i.e. the frequency on which BASE transmits.		
FOLLOWING BLOCK		No following blocks in this type of frame.
Bildkasten		
Reprint		

Cantel Mobitex-

Nr No	91/1056 - A 296	5171/A2 Ue
Format Date	Rev	Pn. P.

1990-02-22 A MTS16A.2

4.16 FRAME TYPE <TST>, Silence order**APPLICATION**

Silence order is used by BASE to withdraw all access permissions during a free cycle. A MOB that is already transmitting may continue to do so, but for every other MOB the access permissions for all traffic types (emergency, speech and data) are withdrawn.

Note: Please also refer to the description of the silence signal in reference RI-17. This signal has the same meaning as the <TST>-frame but uses only the frame head and thus addresses ALL mobile terminals.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
MOB			0	0	0	1	0	0	0	0	0	0	0
33	34	35	36	37	38	39	40	41	42	43	44	45	46
PRIOR		MASK											47 48
49	50	51	52	53	54								144
0	0	0	0	0	0	0	0	0	0	0	0	0	0
145													160
													PARITY

FOLLOWING BLOCK

No following blocks in this type of frame.

Belazart

Report

Cantel Mobitex

No. 91/1056 - A 296 5171/A2 Ue

Date Rec'd 1990-02-22 A MTS16A.2

4.17 FRAME TYPE <AKT>, Activity request

APPLICATION An <AKT> is used by BASE to check whether a certain MOB is active. MOB replies with an <ACK> to such a frame.

PRIMARY BLOCK

01	02	03		22	23	24	25	26	27	28	29	30	31	32
				MOB			0	0	0	1	0	0	0	1
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0	0	0	0	0	0	0	0				BLOCK			
49	50	51	52	53	54									144
0	0	0	0	0	0						0	0	0	0
145														160
											PARITY			

FOLLOWING BLOCK

No following blocks in this type of frame.

DRAFT

REPRINT

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Cantel Mobitex

No. S/N 91/1056	Rev	F. P.L.
Date/Time 1990-02-22	A	MTS16A.2

4.18 FRAME TYPE <NAT>, No access permission, speech

APPLICATION BASE replies with <NAT> to an <ABT> or a line connection request from a MOB when, for some reason, a line connection cannot be set up (e.g. no channel is available).

PRIMARY BLOCK

01 02 03	22 23 24 25 26 27 28 29 30 31 32
MOB	0 0 0 1 0 0 1 0

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48	BLOCK
0 0 0 0 0 0 0 0 0	

49 50 51 52 53 54 55 56 57	'144'
NATFL	0

145	160
PARITY	

NATFL Contains the following orders:
 Bit 49 Leave CURRENT_BASE.
 50 - 56 Reserved

FOLLOWING BLOCK

No following blocks in this type of frame.

Bildkart

Reprok

A 99251503

Cantel Mobitex

Nr. Sc 91/1056 - A 296 5171/A2 Ue	
Format Date 1990-02-22	Rev A
Fil File MTS16A.2	

4.19 FRAME TYPE <BBT>, Change base station, speech.

APPLICATION

BASE will use <BBT>

- as a response to an <ABT> when another base station is to be used for the line connection

or

- to hand over a call in progress to another base station.

PRIMARY BLOCK

01	02	03	22	23	24	25	26	27	28	29	30	31	32
			MOB			0	0	0	1	0	0	1	1

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
					TIMEOUT										BLOCK

49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
BBTFL															

65	66	67	68	69	70	71	72	73	74-75	76	77	78	79	80
SPEECH UPFREQ														

81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
SPEECH DOPREQ															

97	98	99	100													112
BASE																

113																128
NEW SYSTEM UPFREQ																

129																144
NEW SYSTEM DOPREQ																

145																160
PARITY																

Blocks

Repos

A 296 5171

Cantel Mobitex-

No	91/1056 - A 296	5171/A2 Ue
Version Date	1990-02-22	A F. R. MTS16A.2

TIMEOUT	If error, return after TIMEOUT seconds (1-255).
BBTFL	Indicates the terminal is to act after changing to the new base station.
Bit 49	Reserved
50	Reserved
51	After the call, use BASE as new current base station.
52	After the call, return to old current base.
53	Change and start the call set up procedure from the beginning (new <ABT> on BASE).
54	Change and continue (either signalling procedure or call in progress).
55-64	Reserved
BASE	The identity of the new base station to be used.
SPEECH UPFREQ	Frequency number for transmitting speech.
SPEECH DDFREQ	Frequency number for receiving speech.
NEW SYSTEM UPFREQ	Frequency number for upwards traffic on the new system channel, i.e. the frequency on which the terminal transmits.
NEW SYSTEM DDFREQ	Frequency number for downwards traffic on the new system channel, i.e. the frequency on which the terminal receives.
FOLLOWING BLOCK	No following blocks in this type of frame.

This order is only valid if both BBTFL 3 and BBTFL 6 are raised, i.e. hand over of a call in progress.

Other combinations of BBTFL are to be included in later versions.

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Cantel Mobitex-

Ref No	91/1056 - A 296	5171/A2 UE
Date Recd	1 Mar 1990	Fd File MTS16A.2

4.20 FRAME TYPE <VKT>, Wait for channel, speech

APPLICATION BASE replies with one (or more) <VKT>-frame(s) to an <ABT> from a MOB when a speech channel is not immediately available.

PRIMARY BLOCK

01 02 03	22 23 24 25 26 27 28 29 30 31 32
MOB	0 0 0 1 0 1 0 0

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48	BLOCK
0 0 0 0 0 0 0 0	

49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64	QPOS
.	TIMEOUT

65 66 67 68 69 70	144
0 0 0 0 0 0	0 0 0 0 0 0

145	160
	PARITY

TIMEOUT If the mobile terminal has not received a <BKT> or a <NAT> within TIMEOUT seconds (0-255), the <VKT> is invalidated.

QPOS States current position (1-255) in queue. It is recommended that this parameter is passed on to the application layer and shown to the operator.

FOLLOWING BLOCK

No following blocks in this type of frame.

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Cantel Mobitex

No.	91/1056	- A 296	5171/A2 Ue
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Output Date	1990-02-22	Rev.	A
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File No.	MTS16A.2
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4.21 FRAME TYPE <AAT>, Cancel access request, speech

APPLICATION MOB transmits an <AAT> when it wants to end a call and has been placed in a queue by BASE.

PRIMARY BLOCK

01	02	03		22	23	24	25	26	27	28	29	30	31	32
MOB				0	0	0	1	0	1	0	1			
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0	0	0	0	0	0	0	0	0	0	0	0	0	0	48
49	50	51	52	53	54	55	56	57						144
0	0	0	0	0	0	0	0	0						0
145														160
PARITY														

FOLLOWING BLOCK

No following blocks in this type of frame.

Broadcast

Reprod

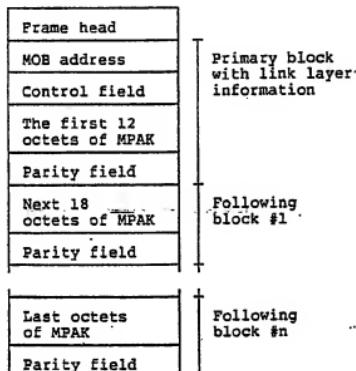
Cantel Mobitex-

Ref No	91/1056 - A 296	5171/A2 Ue
Date Issd	1990-02-22	Rev A

Fl. File MTS16A.2

5 CONVERTING A PACKET TO A FRAME

<MRM>-frames conveys MPAKs over the radio channel. The primary block can accommodate 12 and each following block 18 octets from the MPAK.



When converting a packet to a frame, the first 12 octets in the packet shall be placed in the primary block of the frame. The last octets of the packet are placed in the last block. The primary block indicates how many octets in the last following block that are used. Unused octets in the last following block are filled with octets containing zeros.

In the primary block of the <MRM>-frame the Link Layer information is added. The MOB address field of the primary block shall always contain the MAN of the physical terminal concerned or, when the base station is transmitting to a group, the MAN of the addressed group. The base station identity is contained in the frame head preceding the primary block.

The addresses in the MPAK itself indicates the subscriptions concerned (terminal, transferable or group). For packets to/from the terminal itself or its group numbers, the MOB address field of the primary block and the address in the MPAK are the same. For packets to/from a transferred subscription, the corresponding addresses differ.

Bidders

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St. Nr.	91/1056 - A 296	5171/A2 Ue
Document Date	1990-02-22	A MTS15A.2

6 BLOCK CODING**6.1 GENERAL DESCRIPTION**

The code used is a cyclic block code for burst error control. The code message consists of 144 source data bits and a block check character (CRC, i.e. parity) of 16 bits, giving a total of 160 bits in a block.

The generator polynomial defining the code is

$$g(X) = X^{16} + X^{12} + X^5 + 1$$

i.e. CRC-CCITT X.25.

The CRC is initialized to all ones, calculated from all the 144 source data bits of the block and then its one's complement is transmitted.

This code detects all (single) error bursts up to 16 bits in length and about 99,998% of all other error patterns.

6.2 IMPLEMENTATION

CRC calculations are customarily done in a multi-section shift register which feeds into an exclusive-OR gate whose output feeds back to other XOR gates located in between the sections of the shift register. The placement and quantity of XOR gates are defined by the generator polynomial.

The CRC is then transmitted after the source data of the block.

A logical arrangement identical to that used in the transmitter is also used in the receiver. Again the CRC-register is initialized to all ones, the CRC is calculated from the 144 source bits and its one's complement is compared to the received CRC. If they are different an error has been detected.

Instead of hardware logic a software algorithm may be used.

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Cantel Mobitex-		No. 5 ^o 91/1056 - A 296 5171/A2 UE
Design Date 1990-02-22	B&W	F.A. MTS16A.2

7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RI-06, 7, 31
 RI-09, 8
 RI-17, 35

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RI-01	Arrangement of the documents
RI-02	MOBITEX System description
RI-03	General description of terminals
RI-04	Terminology
RI-05	References
RI-06	Network operator information
RI-08	Application layer
RI-09	Network layer
RI-11	Interface requirements, fixed terminals
RI-12	Other requirements, fixed terminals
RI-16	Link layer, mobile terminals
RI-17	Physical layer, mobile terminals
RI-18	Radio equipment, mobile terminals
RI-19	Other interfaces, mobile terminals
RI-20	Other requirements, mobile terminals

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A 296 5171/A2

		REQUIREMENT SPECIFICATION			Blatt Seite 1(16)
Upperges Progra ET/SYS IK	Frachtmittel bezeichnungsweise ET/SYS IK	No.			
Dokument Güteklasse Dokument-approvate ET/SYSC STT <i>SI</i>		10/1056 - A 296	5171/02 Ue		
Beginnung		Datei-Name	Einf.	F. F. A	
		1990-02-26	A	MTS17.2	
Cantel Mobitex™ MOBITEX Physical Layer, Mobile Terminal 8/16 kbps					

ABSTRACT

This document specifies the Physical Layer for mobile terminals connected to the MOBITEX network.

The exchange of information between base radio station and mobile is done by frames. A frame consists of a frame head and blocks.

The frame head is added to the message sent by the Data Link Layer to establish synchronisation and identify the base station. It also includes a set of control flags.

The blocks in a frame contain the data to/from the Data Link Layer plus parity bits for error correction.

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Cantel Mobitex-

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1 INTRODUCTION

1.1 GENERAL

The protocol in the Physical Layer describes the way the mobile terminal handles the radio channel. The logical structure of the protocol is described in this document, while hardware-related functions such as:

- method of modulation
- suitable equipment for implementation
- requirements for the equipment

are presented in reference R1-18.

Böökert

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Cantel Mobitex-

Nr.	10/1056	- A 296	5171/02 Ue
Design Date	1990-02-26	Rev.	Fc Fd

MTS17.2

2 THE CHANNEL**2.1 GENERAL CHARACTERISTICS**

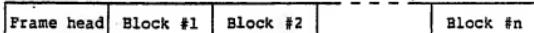
The channel between the base radio station and the mobile terminal uses

- separate frequencies for transmission and reception,
 - synchronous communication and
 - frequency modulation (FM).
- It is also affected by
- varying field-strength,
 - random errors and burst errors caused by fading and noise and
 - bit errors caused by ignition interference.

Consideration has been given to these and other factors in the design of the protocol for the Physical Layer.

2.2 FRAME STRUCTURE

The exchange of information between base station and mobile is done by frames. A frame has the following structure:



The frame head is a very important part of the frame. It is added to the message sent by the Data Link Layer to establish synchronisation and identify the base radio station.

The blocks in a frame contain the data to/from the Data Link Layer plus parity bits for error correction.

When the number of blocks is zero, i.e. when only a frame head is sent, the term "signal" is used.

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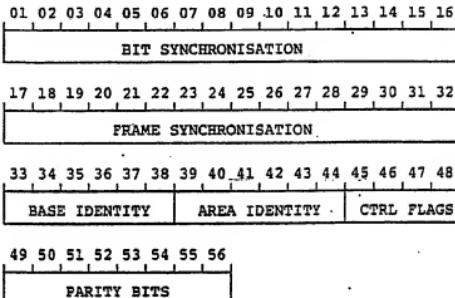
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3 THE FRAME HEAD

3.1 STRUCTURE

The frame head has the following structure:



The different parts of the frame head are described in the following chapters.

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3.2 SYNCHRONISATION

3.2.1 Bit synchronisation

This preamble is provided to enable bit synchronisation in the demodulator. It consists of 16 bits with the following pattern (bit #1 is sent first):

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1

from BASE

from MOB

3.2.2 Frame synchronisation

The frame synchronisation is provided to establish correct code word framing. Each network has its own pattern, used as network identification number, defined in reference RL-06. In order to roam into base radio stations in other networks, it should be possible to manually change the frame synchronisation word from the application layer.

It consists of 16 bits with the following structure, with bit #1 sent first:

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

from BASE

from MOB

If there is more than 1 bit error in the detected pattern, then frame sync is not established.

NOTE Only these 16 bits are used for frame synchronisation.

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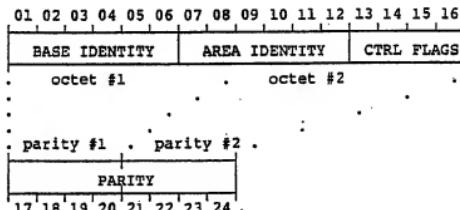
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3.3 AREA IDENTITY, BASE IDENTITY AND CONTROL FLAGS

The base identity (6 bits) and the area identity (6 bits) together, states the unique identity of the base radio station concerned. The most significant bit (01) in the addresses is sent first.

The base identity is followed by four control flags. They are only used in traffic from BASE to MOB. The control flags are as follows (in order of reception):

- 1 SA_flag Reserved for future use.
- 2 Set_slot_flag 0 = FALSE
1 = TRUE, reset slot clock.
- 3 Roaming_flag 0 = FALSE
1 = TRUE, this is a roaming signal, i.e.
it contains only a frame head.
- 4 Silence_flag 0 = FALSE
1 = TRUE, this is a silence signal, i.e.
it contains only a frame head.



The 8 (2^4) parity bits that follow the control flags are encoded in the same way as the blocks of the frame. Parity #1 is coded from octet #1 (see figure above) and parity #2 from octet #2.

The code corrects all single errors. In case the frame head could not be corrected, it should be rejected.

The parity bits may be ignored and the base identity and control flags read without any decoding.

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4 ERROR CORRECTION AND DETECTION

4.1 CODING

Each block to/from the Data Link Layer contains 20 octets of information. These are put into a matrix of the following format:

column -- 1 2 3 4 5 6 7 8 9 10 11 12 .

row 1	octet #1	parity	-----
	2	octet #2	-----

20	octet #20		-----

To each octet (column 1-8) four parity bits are added in the same row (9-12). These are encoded by a shortened (12,8) Hamming code.

The code corrects all single errors with hard decision decoding.

The code is defined by the following H-matrix:

$$H = \begin{bmatrix} 11101100 & 1000 \\ 11010011 & 0100 \\ 10111010 & 0010 \\ 01110101 & 0001 \end{bmatrix}$$

The syndrome (s) is calculated from the received code word (v) by

$$s = vH^T$$

where H^T denotes the transposed H-matrix.

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The syndrome of a code word with a single error is equal to the columnvector of the H-matrix corresponding to the position of this error. The syndrome table is shown below.

syndrome	corresponds to a single error in bit position
0	-
1	0000 0000 0001
2	0000 0000 0010
3	-
4	0000 0000 0100
5	0000 0001 0000
6	0000 0010 0000
7	0001 0000 0000
8	0000 0000 1000
9	0000 0100 0000
10	0000 1000 0000
11	0010 0000 0000
12	-
13	0100 0000 0000
14	1000 0000 0000
15	-

If the syndrome is 0 the code word is correct.

The following examples illustrate the coding/decoding procedure:

transmitted info	parity	received info	parity	syndrome
0000	0001	0101	0000	0000
0000	0101	1100	0101	1010
0000	0010	0110	0010	1011
0000	0101	1100	0000	1100

Blocker:

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4.2 INTERLEAVING AND SCRAMBLING

Before transmission the code is interleaved to give protection against burst errors. The block-matrix is sent columnwise with start at position (1,1) and is received in the same way.

column -- 1 2 3 4 5 6 7 8 9 10 11 12

row 1	octet #1	parity
2	octet #2	
20	octet #20	

The code without interleaving can correct single errors. The interleaved code can thus correct a burst of 20 errors, assuming that there is no other error in the same block.

Scrambling

At transmission and reception the bits following the frame head should be added modulo-2 (exclusive-ored) with the output from the ninth stage of a binary nine-stage shift register.

The outputs of the fifth and ninth stage of the shift register should be added modulo-2 and the result fed back to the input of the first stage.

All bits in the shift register should be sent to the logical value 1 upon initialization for reception or transmission.

That is, the bits following the frame head will be exclusive-ored with the sequence:

11111111000001111011111000101..., etc.

This scrambling sequence is the recommended test sequence described in CCITT recommendation V.52, as well as the shift register on the next page.

Note: It should be possible, via a test command in MASC (reference R1-19), to order the mobile to start/stop sending the above described scrambling sequence. This should only be possible during test, not during normal operation.

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Shift register stages during pseudo-random pattern generation.

1	2	3	4	5	6	7	8	9	Out
1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1
0	0	1	1	1	1	1	1	1	1
0	0	0	1	1	1	1	1	1	1
0	0	0	0	1	1	1	1	1	1
0	0	0	0	0	1	1	1	1	1
1	0	0	0	0	0	1	1	1	1
1	1	0	0	0	0	0	1	1	1
1	1	1	0	0	0	0	0	1	1
1	1	1	1	0	0	0	0	0	0
0	1	1	1	1	0	0	0	0	0
1	0	1	1	1	1	0	0	0	0
1	1	0	1	1	1	1	0	0	0
1	1	1	0	1	1	1	1	0	0
1	1	1	1	0	1	1	1	1	1

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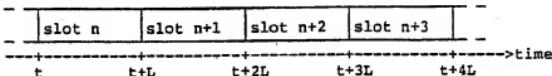
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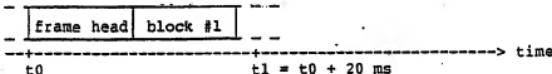
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5 TIME DIVISION

The time axis is divided into slots. The length (L) of one of these slots is given by the parameter Slot_length.



The mobile keeps a clock going to be able to detect slot boundaries. The start (t_1) of the first slot in a sequence is defined by BASE transmitting a frame head with a Set_slot_flag.



The first bit of the frame head is received at time t_0 .
Slot number n starts at:

$$t = t_1 + (n-1)*L$$

where

$$\begin{aligned} L &= \text{Slot_length} * (32/\text{bitrate}) \text{ seconds} \\ n &= 1..x \end{aligned}$$

The tolerance for determining the start of a slot is -0.1/+3 ms.

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6 TRANSMISSION

When an order to transmit a frame (FRAME TO SEND) has come from the Data Link Layer, the Physical Layer first waits until the slot clock reaches the CHOSEN_SLOT (please also refer to chapter 8) before it:

- indicates SLOT_REACHED to the Data Link Layer
- switches the carrier on
- waits until carrier frequency and power has stabilized
- waits 5 ms (tolerance -0/+5 ms)
- sends frame head with base and area identity (from Current_base) and all control flags = 0 (i.e. FALSE)
- encodes and sends all blocks of the frame

before it switches the carrier off and indicates FRAME SENT to the Data Link Layer. If the order CANNOT_SEND comes from the Data Link Layer before the CHOSEN_SLOT is reached, then the transmission will not be started.

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7 RECEPTION

The following takes place when correct bit and frame synchronisation has been established:

```

get average signal strength during reception of
frame head *)
send Received base to Data Link Layer
IF received Base = Current_base THEN
  IF Silence_flag THEN
    send Silence to Data Link Layer
  ELSE
    IF Set_slot_flag THEN
      reset slot clock
    ENDIF
    REPEAT
      read block
      decode block
      send Received_block to Data Link Layer
    UNTIL Sync_search
  ENDIF
ENDIF

```

On reception of the order Measure_RSSI from the Data Link Layer, the average signal strength *) is measured during the time stated in the order. Thereafter an answer, RSSI_measured, is sent to the Data Link Layer.

*) The RSSI should be sampled with a frequency of 1000 samples per second.

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<u>8 INTERFACE TO THE DATA LINK LAYER</u>		
<p>Parameters received from the Data Link Layer:</p> <ul style="list-style-type: none"> Slot_length - states the length of a single slot. The unit is (32/bitrate) seconds. Chosen_slot - states the slot where transmission starts. Current_base - states which base radio station is currently used (base and area identity). Frame_to_send - is a message consisting of at least one block. Frame_length - states the number of blocks in message. Sync_search - orders the Physical Layer to stop reading and enter sync search mode. Cannot_send - orders the Physical Layer not to send in any slot. Measure_RSSI - orders the Physical Layer to measure the average received signal strength, during the time stated in the order. 		
<p>Parameters sent to the Data Link Layer:</p> <ul style="list-style-type: none"> Frame_sent - indicates that a frame transmission is completed. Received_block - is a decoded block (w error indication). Received_base - states the base identity, area identity and the received signal strength in dBuV. Silence - indicates that we have received a silence signal. Slot_reached - indicates the start of the Chosen_slot. RSSI_Measured - the average received signal strength, during in order Measure_RSSI stated time. 		
<input type="checkbox"/> Blockset <input type="checkbox"/> Repro		

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9 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

- R1-06, 6
- R1-18, 3
- R1-19, 10

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

Editor

Revisor

REQUIREMENT SPECIFICATION
1(21)

Urgency Priority ET/UC SIS		Placing into Service ET/UC SIS		No. Nr. 1056 - A 296 5173/04 Ue	Last Page 1(21)				
Document-Number - Der Report besteht aus ET/SYSC STT 571				Change - Date 1990-02-25 A	Rev MTS18.2	F. File			
Beginning				MOBITEX Mobile radio equipment 8 kbit/s, 12.5 kHz channel spacing					
Cantel Mobitex									
ABSTRACT									
<p>This document specifies the requirements for the radio transmitter and receiver in the MOBITEX MOBILE TERMINAL.</p> <p>The document contains a functional description and a detailed specification of the technical requirements and performance of the transmitter and receiver.</p> <p>The equipment specified in this document should also meet with basic requirements set up in national regulations for radio transmitters and radio receivers.</p> <p>Environmental, power supply and operational control requirements are found in the document General Requirements for the Mobile Terminal.</p>									
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1 INTRODUCTION

1.1 GENERAL

The radio transceiver serves as interface between the radio path and the logic and control unit of the mobile terminal. Data and voice transmission is provided.

The transmission mode is semi-duplex, the base station operates in full duplex mode and the mobile station in two frequency simplex mode.

Digital FM modulation is used for data transmission at a speed of 8 kbit/s.

The channel spacing is 12.5 kHz.

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2 FUNCTIONAL DESCRIPTION2.1 DATA TRANSMISSION

The main traffic in the Mobitex network will be of the data transmission type.

A modulation type which makes it possible to utilize the radio transceiver for speech transmission as well as for data transmission has been chosen.

The modulation type is binary digital baseband filtered FM at a speed of 8 kbit/s.

There should be no squelch function during data transmissions.

During data transmissions the audio paths for speech transmissions to be muted.

The data transmission mode is used for transmission of system information, system orders and for the signalling between the base station and the mobile station as well as for the user data and text transmissions.

The data transmission mode is basically a simplex mode, data transmission takes place only in one direction at a time. Short switchover times are important as this will increase the system efficiency.

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2.2 SPEECH TRANSMISSION

The speech transmission mode is only reached after a request from either a mobile or a fixed terminal.

After a request for speech communication the base station allocates a radio channel and sends an order to the mobile station to switch over to that channel (separate transmit and receive frequencies).

No squelch function is to be used during speech communication.

The muting of the audio paths is released during speech communication. If, however, a data signal is detected during the speech, the audio paths to be muted immediately. This will for example occur when a data message is received during ongoing speech conversation.

2.3 TRANSMITTER CONTROL

2.3.1 Frequency

The transmitter frequency is controlled by the control unit.

For information about frequency band and channel numbering plan to be used, please refer to document R1-06.

2.3.2 Carrier

The carrier on/off condition is controlled by the control unit during data transmissions. During speech transmission the carrier on/off condition is controlled by the manually operated transmit/receive switch.

Requirements of dynamic output power control can be made. In such a case, these are stated in reference R1-06.

There is to be a control circuit, independent of all other logic, which prohibits the continuous transmission of carrier for longer periods than 10 minutes.

2.3.3 Audio muting

The voice signal to the transmitter to be muted during data transmissions.

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2.4 RECEIVER CONTROL**2.4.1 Frequency**

The receiver frequency is controlled by the control unit.

For information about frequency band and channel numbering plan to be used, please refer to document R1-06.

2.4.2 Squelch control

There must be no squelch function in the receiver.

2.4.3 Signal strength indication

The received signal strength level is used in the roaming algorithm for selection of base station.
Please refer to chapter RECEIVER in this document which includes a specification of the signal strength indication.

2.4.4 Audio muting

Whenever a data signal is detected, e.g detection of frame synchronization, the receiver voice output should be muted.

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3 PERFORMANCE AND TECHNICAL REQUIREMENTS

3.1 GENERAL

For definitions and measurement methods, please refer to Appendix A.

3.1.1 Frequency range

For information about which frequency band and channel numbering plan etc that will be used, please refer to document RI-06.

3.1.2 Frequency error

The frequency error of the transmitter and receiver shall not exceed (+)(-) 1.5 ppm.

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3.1.3 Data transmission

3.1.3.1 Modulator

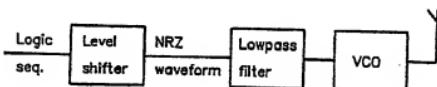


Figure 1. Block diagram of the method of modulation.

The modulation type is binary digital baseband filtered FM at a speed of 8 kbit/s. The method of modulation is shown in principle in Figure 1. The logic sequence to transmit is converted to a binary NRZ waveform by a level shifter and the NRZ waveform is filtered by a lowpass filter with linear phase-characteristic.

The filtered waveform is applied as control input to a VCO, a voltage controlled oscillator. The lowpass filter reduces the deviation of the modulator for the high-frequency components of the binary modulating signal and thereby reduces the out of band emission of the transmitter.

A sequence of logic 1's should yield a transmitter frequency 2.0 kHz higher than the channel center frequency. A sequence of logic 0's should yield a transmitter frequency 2.0 kHz lower than the channel center frequency. That is the modulation index is 0.5.

The filter (or the equivalent filter in case of an other implementation) shall be a low pass filter with linear phase characteristic and a 3-dB frequency of 2.4 kHz. At a frequency two (2) times the 3-dB frequency the attenuation of the filter shall be 12 dB, and at a frequency four (4) times the 3-dB frequency the attenuation of the filter shall be 48 dB. The high frequency roll-off of the filter must be at least 40 dB/octave. A high frequency attenuation of 70 dB is considered sufficient. Figure 2 shows the amplitude response of the filter. The frequency modulator should be of a wide band linear type with frequency independent response in the frequency range 0 - 4 kHz or otherwise compensated in the baseband filter. An eye diagram of the transmitted signal is shown in Figure 3.

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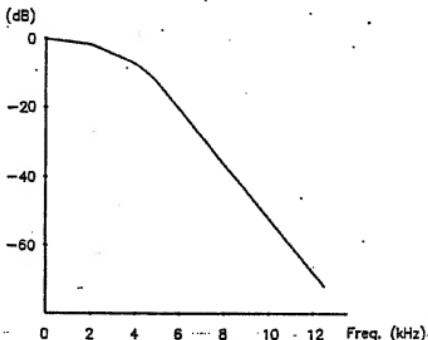


Figure 2. Amplitude response of lowpass filter.

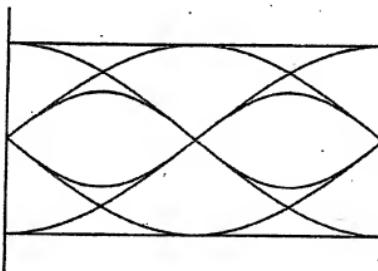


Figure 3. Eye diagram.

A preferred implementation of the baseband processing is oversampling of the bit-stream 4 - 8 times and digital filtering in a FIR (finite impulse response) filter with symmetric coefficients. This type of implementation can be realized by simple table look-up in a PROM.

The modulation rate is 8 kbits per second. The frequency error of the bitrate clock should not exceed ± 10 ppm. The error of the modulation index should not exceed $\pm 5\%$.

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3.1.3.2 Demodulator

The demodulator should be of non-coherent type. A simple decision feedback or sequence detector should be used to resolve the small receiver eye opening of two subsequent bit transitions. A required bit error rate (BER) curve as a function of receiver input in a static receiver noise limited situation is shown in Figure 4.

The performance requirement of the complete receiving equipment when connected to a reference data transmitter is that the decoded block error rate should be less than 0.1 at the reference RF input signal level. At an RF input signal level 30 dB above the the reference level, the decoded block error rate should be less than 0.0001.

It is essential that the demodulator keeps the synchronism with the incoming bit-stream during an entire message, even under disturbed conditions, in order to avoid repetition of other blocks than those which were actually disturbed.

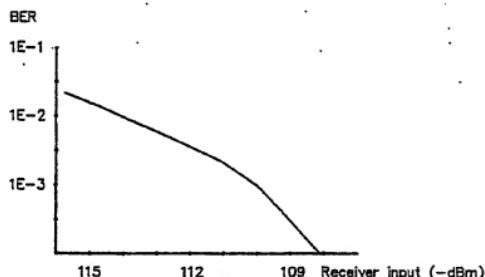


Figure 4. Bit error rate versus receiver input level.

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3.1.3.3 Start of data modulation

Data modulation must not start until the carrier frequency is within its 200 Hz from its steady state value and the carrier power is within 2 dB from its steady state value.

The transmitter carrier should be on for 5 -0/+5 ms before the start of transmission (frame head).

3.1.3.4 Receive/transmit switching times

The switching time from receive to transmit condition to be less than 20 ms including CPU handling time.

The switching time from transmit to receive condition to be less than 20 ms including CPU handling time.

3.1.4 Test terminals

Please note that the transceiver input/output terminals for voice must be accessible.

An interface according to the "machine interface" defined in reference RI-19, must be available during testing.

3.1.5 Test modulation

Short and long frames as defined in the link layer will be used during tests of data transmission.

It should be possible to force the modem to continuously transmit a sequence as specified in the national requirements for out of band emission testing.

It should be also be possible to force the modem to continuously transmit the scrambling sequence that is specified in Physical Layer Specification of the mobile terminal.

Normal audio test modulation is a 1 kHz test tone at such a level that the resulting deviation is +- 1.5 kHz.

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3.2 TRANSMITTER

For definitions and measurement methods, please refer to Appendix A.

3.2.1 Carrier power

The nominal output power is stated in reference R1-06. Requirements of dynamic output power control can be made. In such a case, these are also stated in reference R1-06.

Under normal test conditions and independent of selected channel the carrier output power during carrier on condition to be within $(+/-) 1,5$ dB of the nominal output power. Under extreme test conditions the carrier output power to be within +2 dB and -3 dB of the nominal output power.

When the transmitter is in the carrier off condition, the carrier output power should not exceed 0,25uW.

The transmitter to be able to withstand load tests as described below:

- the change in the transmitter output power should not exceed 2 dB during a load test when the transmitter is loaded with a resistive load giving a standing wave ratio of 2. The test to be done at normal test conditions during 5 minutes of continuous transmission.
- without being damaged the transmitter should be able to withstand the same test at extreme test conditions.
- without being damaged the transmitter should be able to transmit for a period of 1 minute with the antenna terminal left open.
- the last mentioned test to be repeated with the antenna terminal short-circuit.

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3.2.2 Carrier rise and fall time

The carrier rise time and carrier fall time are included in the transmit-receive and receive-transmit switching times. Please refer to chapter "Receive/transmit switching times" in this document.

3.2.3 Channel switching time

The channel switching time should not exceed 30 ms.

3.2.4 Frequency deviation

3.2.4.1 Maximum permissible deviation

The maximum permissible frequency deviation to be (+)(-)2.5 kHz.

3.2.4.2 Data modulation

A long sequence of logic 1's (0's) should produce a carrier frequency deviation of +(-, for 0's) 2.0 kHz \pm 0.1 kHz.

3.2.4.3 Audio modulation

The normal audio test tone will produce a deviation of \pm 1.5 kHz.

3.2.4.4 Audio frequency response

The audio frequency response, measured through the audio signal input terminal, should have a 6 dB/octave pre-emphasis between 300 Hz to 2500 Hz. For frequencies higher than 3000 Hz, the frequency response should have a roll-off of at least 30 dB/octave.

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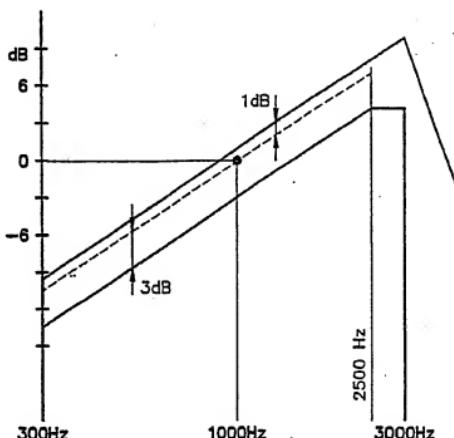


Figure 5. Frequency deviation relative to 1 kHz at constant input level.

3.2.5 Adjacent channel power

The adjacent channel power should not exceed the value specified in the national technical requirements, in case such a value is specified in the national technical requirements.

3.2.6 Harmonic distortion

The harmonic distortion factor should not exceed 5%.

3.2.7 Residual modulation

The residual modulation should not exceed - 40 dB, measured with a psophometric filter.

The residual modulation should not exceed - 20 dB, measured without filter.

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<p>3.2.8 <u>Modulation due to vibration</u></p> <p>The modulation due to vibration should not exceed -30 dB measured by a r.m.s. voltmeter and with a psophometric filter.</p> <p>Without the psophometric filter and measured by a peak-to-peak voltmeter the modulation should not exceed -14 dB.</p> <p>3.2.9 <u>Audio muting</u></p> <p>An input muting device controlled by the control unit should be provided. The muting to be capable of causing at least 40 dB attenuation in the voice path. Data transmission is not to start until the muting has reached an attenuation of 40 dB.</p>		
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3.3 RECEIVER

For definitions and measurement methods, please refer to Appendix A.

3.3.1 Channel switching time

The channel switching time should not exceed 30 ms including data signal detection time.

3.3.2 Squelch opening and closing levels and delays

There must be no squelch function in the receiver.

3.3.3 Signal strength indication

The signal strength to be indicated by the receiver to the control unit.

The indicated range to be :

RF-level, 0 - 50 dBuV emf with a monotonic output
and absolute accuracy of
 $\pm(2 + 10\% \text{ of actual value})$ dBuV emf.

The time constant to be 1 ms.

3.3.4 RF sensitivity

The receiver sensitivity (speech) not to exceed 0 dBuV emf under normal test conditions and + 4 dBuV emf under extreme test conditions.

The reference signalling sensitivity (data) not to exceed 0 dBuV emf under normal test conditions, and 3 dBuV emf under extreme test conditions.

The multipath signalling sensitivity (data) must not exceed 12 dBuV emf. This measurement is only done under normal test conditions.

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3.3.5 Adjacent channel selectivity

The receiver shall comply with applicable national technical requirements.

3.3.6 Spurious response rejection

The receiver shall comply with applicable national technical requirements.

3.3.7 Co-channel rejection

The measurement is made with the wanted signal at an input level of +10 dBuV emf.

The co-channel rejection level at any frequency displacement of the unwanted signal within the specified range to be greater than -2 dBuV emf.

3.3.8 Intermodulation response

The receiver shall comply with applicable national technical requirements.

3.3.9 Blocking

The receiver shall comply with applicable national technical requirements.

3.3.10 Amplitude characteristic of the receiver

For the specified change of radio frequency input level, the change of the audio output level should not exceed 3 dB between the maximum and minimum output levels.

3.3.11 AM-suppression

The AM-suppression should not be less than 30 dB.

3.3.12 Audio frequency response

The audio frequency response, measured at the audio output terminal, should be within the limits as shown in the figure below.

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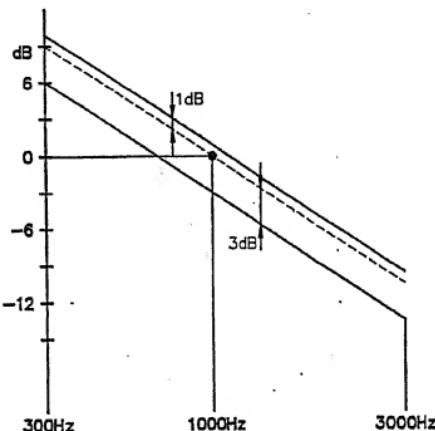


Figure 6. Audio power relative to 1kHz at constant frequency deviation.

3.3.13 Harmonic distortion

At all audio frequencies used in the measurement and under all test conditions the harmonic distortion factor should not exceed 5%.

3.3.14 Noise and hum

The receiver "noise and hum" ratio should not exceed -40 dB measured by a.r.m.s. voltmeter and with a psophometric filter.

Without the psophometric filter and measured by a peak-to-peak voltmeter the "noise and hum" ratio should not exceed -20 dB.

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3.3.15 Audio output due to vibration

The noise and hum ratio of the receiver due to vibration should not exceed -30 dB measured by a r.m.s.voltmeter through a psophometric filter.

Without the filter and measured by a peak-to-peak voltmeter the the ratio should not exceed -14 dB.

3.3.16 Audio muting

An output muting device controlled by the control unit to be provided. The muting device to be capable of causing at least 40 dB attenuation in the voice path.

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4 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RL-06, 6, 7, 8, 13
 RL-19, 12

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RL-01	Arrangement of the documents
RL-02	MOBITEX System description
RL-03	General description of terminals
RL-04	Terminology
RL-05	References
RL-06	Network operator information
RL-08	Application layer
RL-09	Network layer
RL-11	Interface requirements, fixed terminals
RL-12	Other requirements, fixed terminals
RL-16	Link layer, mobile terminals
RL-17	Physical layer, mobile terminals
RL-18	Radio equipment, mobile terminals
RL-19	Other interfaces, mobile terminals
RL-20	Other requirements, mobile terminals

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Requirement Specification
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Document Prepared ET/UC SIS	Document Reviewer ET/UC SIS	No. Ref. A/1056 - A 296 5173/01 Ue
Document Controlled - Document Description ET/SYSC STT 377		Date Rev. P. Fca 1990-02-23 C MTS18A.1
Cantel Mobitex <i>Appendix A, Measurement methods</i>		

1. INTRODUCTION

This document is an Appendix to MOBITEX TERMINAL SPECIFICATION - RADIO EQUIPMENT. It consists of requirement definitions and measurement method descriptions.

The measurement values applies to 12,5 kHz channel spacing in the 900 MHz frequency band.

The document describes measurement methods for several data transmission speeds. Therefore, measurements without specified requirement procedures in the main document can be found. These should be ignored.

The equipment specified in this document should also meet with basic requirements set up in national regulations for radio transmitters and radio receivers.

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2 MEASUREMENT METHODS

2.1 SYSTEM MEASUREMENTS

2.1.1 Receive to transmit switching time

Definition:

The switching time from receive to transmit condition is defined as the elapsed time from the end of an incoming frame with the response flag set, to the beginning of the response, i.e. the data signalling starts (see main document "Start of data modulation").

2.1.2 Transmit to receive switching time

Definition:

The switching time from transmit to receive condition is defined as the elapsed time from end of the last frame in a message sent by the transmitter, until the receiver is capable of detecting incoming data signals.

2.1.3 Channel switching time

Definition:

The channel switching time is defined as the elapsed time from the end of a received order to change channel, until the receiver is capable of detecting data signals on the new channel.

2.1.4 Frequency error

Definition:

The frequency error of the transmitter is the difference between the measured carrier frequency and its nominal value.

Method of measurement:

The carrier frequency should be measured in the absence of modulation with the transmitter connected to an artificial antenna.

The test should be made under normal and extreme test conditions.

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2.2 TRANSMITTER MEASUREMENTS

2.2.1 Carrier power

Definition:

The transmitter carrier power is the mean power delivered to the artificial antenna during a radio frequency cycle in the absence of modulation.

Method of measurement:

The transmitter should be connected to an artificial antenna and the power delivered to this artificial antenna should be measured.

The measurements should be made under normal and extreme test conditions.

2.2.2 Maximum permissible frequency deviation

Definition:

The frequency deviation is the maximum difference between the instantaneous frequency of the modulated radio frequency signal and the carrier frequency in the absence of modulation.

Method of measurement:

The frequency deviation should be measured at the output of the transmitter connected to an artificial antenna, by means of a deviation meter capable of measuring the maximum deviation, including that due to any harmonics and intermodulation products which may be generated in the transmitter.

2.2.3 Audio frequency response

Definition:

The audio frequency response is the frequency deviation of the transmitter carrier as a function of modulation frequency at a constant level of the modulation signal.

Method of measurement:

A modulation signal at a frequency of 1000 Hz and adjusted to such level that a frequency deviation of (+/-)0,5 kHz is obtained, is applied to the transmitter. The frequency

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of the modulation signal is then varied between 300 Hz and 25 kHz, its level being kept constant. The connection values of frequency deviation and modulation frequency should be determined.

2.2.4 Adjacent channel power

Definition:

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within a specified passband centred on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

Method of measurement:

The adjacent channel power should be measured with a power measuring receiver which fulfills the requirements given in the CEPT recommendation T/R 24-1. The transmitter should be operated at the nominal carrier power under normal test conditions. The output of the transmitter should be linked to the input of the receiver by connecting device such that the impedance presented to the transmitter is 50 ohms and the level at the "receiver" input is appropriate.

The transmitter should be modulated with a signal of 1250 Hz.

The signal of 1250 Hz should be adjusted to a level 20 dB higher than that required to produce (+)(-)1,5 kHz deviation. The "receiver" should be tuned to the nominal frequency of the transmitter and the variable attenuator in the "receiver" should be adjusted to a value p dB such that a meter reading of the order of 5 dB above the "receiver" noise level is obtained.

The "receiver" should then be tuned to the nominal frequency of one of the adjacent channels and the variable attenuator should be adjusted to a value q dB such that the same meter reading is obtained.

The measurement should be repeated with normal data test modulation (paragraph Test modulation, in the Main document).

The ratio of adjacent channel power to carrier power is the difference between the attenuator settings p and q. The adjacent channel power is determined by applying this ratio to the carrier power.

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The measurement should be repeated for the other adjacent channel.

2.2.5 Harmonic distortion

Definition:

The harmonic distortion factor of a transmitter modulated by an audio frequency signal is defined as the ratio, expressed as a percentage, of the r.m.s. voltage of all the harmonic components of the fundamental audio frequency to the total r.m.s. voltage of the signal after linear demodulation.

With the method described below, when a distortion meter is used, the hum and noise components are included in the distortion measurement.

Method of measurement:

The radio frequency signal produced by the transmitter is applied, by means of a suitable coupler, to a linear demodulator equipped with a de-emphasis network of 6 dB per octave.

The radio frequency signal to be modulated successively at frequencies of 300, 500 and 1000 Hz frequency to (+)(-)1.5 kHz deviation.

The harmonic distortion factor of the audio frequency signal is measured at all the frequencies given above.

2.2.6 Residual modulation

Definition:

The residual modulation of the transmitter is the ratio, expressed in dB, of the audio frequency noise level produced after radio frequency signal demodulation, in the absence of modulation, by the wanted signal, by the spurious effects of the power supply system, by the modulator or by other causes, to the audio frequency level produced by normal test modulation applied to the transmitter.

Method of measurement:

- a) The normal test modulation is applied to the transmitter. The RF signal produced by the transmitter is applied by means of a suitable coupler to a linear demodulator.

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The demodulator is equipped with a de-emphasis network of 6 dB per octave.

All precautions should be taken to prevent the measurement results from being affected by emphasis at the low audio frequencies of the internal linear demodulator noise.

Measurements to be carried out on the demodulator output signal by means of an r.m.s. voltmeter equipped with psophometric filter network described in CCITT Recommendation P.53.A.

The modulation is then removed and the level of the residual audio frequency output signal is again measured.

- b) The same method as a) above but without the psophometric filter at the output.

In this case the measurements are carried out by means of a peak-to-peak voltmeter.

2.2.7 Modulation due to vibration

Definition:

Modulation due to vibration denotes the ability of the transmitter to withstand influence on the radio frequency output signal by mechanical vibrations.

Method of measurement:

The residual modulation is measured in accordance with 5.2.2. The transmitter should during the test be vibrated in each of three directions:

10 - 100 Hz 1 m/s^2

sweep rate 1 octave per minute

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2.3 RECEIVER MEASUREMENTS

2.3.1 RF sensitivity

Definition:

The maximum usable sensitivity of the receiver is the minimum level of signal (emf) and field-strength respectively at the receiver input, at the nominal frequency of the receiver, with normal test modulation which will produce:

an audio-frequency output power of at least 50% of the rated power output and

a SND/ND ratio (S=signal, N=noise, D=distortion) of 20 dB, measured at the receiver output through a telephone psophometric weighting network as described in CCITT Recommendation P.53-A.

Note: The characteristics of the 1 kHz band-stop filter used in SND/ND measurements should be such that at the output the attenuation at 1 kHz will be at least 40 dB and at 2 kHz will not exceed 0.6 dB. The filter characteristics should be flat within 0.6 dB over the ranges of 20 Hz to 500 Hz and 2 kHz to 4 kHz. In the absence of modulation of the total noise power at the audio-frequency output of the receiver under test.

The reference signalling sensitivity data is the level and field-strength respectively of a radio frequency input signal at the nominal receiver frequency and modulated with the normal coded test signal or pseudo-random bit sequence which will produce a successful calling ratio of 80% for signalling systems with a specific response as output and a bit error ratio of 0.01 for data transmission systems with a bit stream as output respectively.

Measurement methods:

A signal of carrier frequency equal to the nominal frequency of the receiver and with normal test modulation shall be applied to the receiver input terminals. An audio frequency output load and a distortion factor meter incorporating a 1 kHz band-stop filter and a psophometric telephone weighting network shall be connected to the receiver output terminals. Where possible, the receiver volume control shall be adjusted to give at least 50% of the rated output power. The test signal input level shall be reduced until a SND/ND ratio of 20 dB is obtained. The test signal input level under these conditions is the maximum usable sensitivity. The measurement shall be made under normal test conditions and extreme test conditions. Under extreme test conditions, a variation of the receiver

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output power of (+)(-) 3 dB from the value obtained under normal test conditions may be allowed.

A signal of carrier frequency equal to the nominal frequency of the receiver and modulated with the normal coded test signal or a pseudo-random bit sequence shall be applied to the receiver input terminals. The level of this signal shall be such that a successful calling ratio of SCR = 80%, and a bit error ratio of BER = 0.01 respectively is obtained. The reference signalling sensitivity (data) is the maximum level of the levels recorded for SCR = 80% and BER = 0.01.

The multipath signalling sensitivity is the rms value of the level of a Rayleigh fading input signal at the nominal receiver frequency and modulated with the normal coded test signal or pseudo-random bit sequence which will produce a successful calling ratio of 80% and a bit error rate of 0.01. The measurements shall be carried out with a Rayleigh fading simulator set for a simulated vehicle speed of 90 km/h and repeated for a simulated vehicle speed of 50 km/h and 10 km/h. The reference multipath signalling sensitivity (data) is the maximum necessary level of the multipath measurements.

2.3.2 Adjacent channel selectivity

Definition:

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

Method of measurement:

Two signals should be applied to the receiver via a combining network. The wanted signal should be at the nominal frequency of the receiver and be modulated with normal test modulation. The unwanted signal should be at the nominal frequency of the upper adjacent channel and be modulated with a 400 Hz tone to a frequency deviation of (+)(-)1,5 kHz.

Initially the unwanted signal should be switched off and the level of the wanted signal should be adjusted to 6 dBuV^{emf}. The unwanted signal should then be switched on and its level adjusted until the SND/ND ratio, measured at the receiver line output terminal through the psophometric filter, is reduced to 14 dB.

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The measurement should be repeated with the unwanted signal at the nominal frequency of the lower adjacent channel.

The adjacent channel selectivity should be expressed as the lower value of the receiver input levels in dBuV emf of the unwanted signal for the upper and lower adjacent channels.

2.3.3 Spurious response rejection

Definition:

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal of the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

Method of measurement:

Two input signals should be applied to the receiver via a combining network. The wanted signal should be at the nominal frequency of the receiver and be modulated with normal test modulation. Initially the unwanted signal should be switched off and the wanted input signal adjusted to 6 dBuV emf. The unwanted signal should be switched on and modulated with a 400 Hz tone to a frequency deviation of (+/-)1,5 kHz. The input level of the unwanted signal should be 86 dBuV emf and its frequency should be varied at least from 100 kHz to 2000 MHz.

At any frequency at which a response is obtained, the input level of the unwanted signal should be adjusted until the SND/ND ratio, measured at the line output terminal of the receiver through the psophometric filter, is 14 dB.

The spurious response rejection should be expressed as the level in dB of the unwanted signal relative to 1 uV emf at the receiver input when the SND/ND ratio of 14 dB, as mentioned above, is obtained.

2.3.4 Co-channel rejection

Definition:

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

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Method of measurement:		
<p>Two input signals should be applied to the receiver via a combining network. The wanted signal should have normal test modulation. The unwanted signal should be modulated with a frequency of 400 Hz to a frequency deviation of (+)(-)1,5 kHz. Both input signals should be at the nominal frequency of the receiver and the measurement should be repeated for displacements of the unwanted signal up to (+)(-)1,5 kHz offset frequency of the nominal frequency.</p>		
<p>Initially the unwanted signal should be switched off and the level of the wanted signal should be adjusted to +6 dBmV emf. The unwanted signal should then be switched on.</p>		
<p>The level of the unwanted signal should be adjusted until the SND/ND ratio, measured at the line output terminal of the receiver through the psophometric filter, is reduced to 14 dB.</p>		
<p>The co-channel rejection should be expressed as the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input for which SND/ND = 14 dB at the receiver line output terminal occurs.</p>		
<h3>2.3.5 <u>Intermodulation response</u></h3>		
<p>Definition:</p>		
<p>The intermodulation response is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.</p>		
<p>Method of measurement:</p>		
<p>Three signal generators, A, B and C, should be connected to the receiver via a combining network.</p>		
<p>The wanted signal, represented by signal generator A, should be at the nominal frequency of the receiver and should have normal test modulation.</p>		
<p>The unwanted signal from signal generator B should be unmodulated and adjusted to the frequency separated by 25 kHz above the nominal frequency of the receiver.</p>		
<p>The second unwanted signal from signal generator C should be modulated with a frequency of 400 Hz with a deviation of 1,5 kHz and adjusted to the frequency 50 kHz above the nominal frequency of the receiver.</p>		
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The amplitude of the wanted input signal should be adjusted to 6 dBuV emf. The amplitude of the two unwanted signals should be maintained equal and should be adjusted until the SND/ND ratio at the receiver output, psophometrically weighted, is reduced to 14 dB.

The frequency of signal generator B should be adjusted slightly, if necessary, to produce the maximum degradation of the SND/ND ratio. The level of the two unwanted test signals should be readjusted to restore the SND/ND ratio of 14 dB.

The measurement should be repeated with the unwanted signal B at 25 kHz below that of the wanted signal and the frequency of the unwanted signal C at 50 kHz below that of the wanted signal.

The intermodulation response level is the receiver input level in dB produced by each of the two unwanted signal generators relative to 1 uV emf.

2.3.6 Blocking

Definition:

Blocking is a change (generally a reduction) in the wanted output power of a receiver or a reduction of the SND/ND ratio due to an unwanted signal on another frequency.

Method of measurement:

Two input signals should be applied to the receiver via a combining network. The wanted signal should be at the nominal frequency of the receiver and should have normal test modulation. Initially the unwanted signal should be switched off and the input level of the wanted signal should be adjusted to 6 dBuV emf.

The output power of the wanted signal at the line output terminal of the receiver should be adjusted to the nominal output level. Then the unwanted signal should be switched on. The unwanted signal should be unmodulated, and its frequency should be varied between +1 MHz and +10 MHz, and also between -1 MHz and -10 MHz, relative to the nominal frequency of the receiver. The input level of the unwanted signal, at all frequencies in the specified ranges, should be so adjusted that the unwanted signal causes:

a) a reduction of 3 dB in the audio frequency output power of the wanted signal,

or

b) a reduction of the SND/ND ratio to 14 dB, measured through a psophometric filter,

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Pl. Pd.	MTS18A.1

whichever occurs first.

This input level is the blocking level at the frequency concerned.

2.3.7 Amplitude characteristics

Definition:

The amplitude characteristics of the receiver is the relationship between the radio frequency input level of specified modulated signal and the audio-frequency level at the receiver output.

Method of measurement:

A test signal at a level of 6 dBuV emf at the nominal frequency of the receiver and having normal test modulation should be applied to the receiver input. The audio frequency power at the line output should be adjusted to the nominal level. The input signal should be increased to 100 dBuV emf, and the audio frequency output level should again be measured.

2.3.8 AM-suppression

Definition:

AM-suppression is the capability of the receiver to suppress amplitude modulated signals. It is expressed as the ratio in dB of the audio power at the line output terminal with normal test modulation to the audio power with a specified amplitude modulation.

Method of measurement:

A test signal at a level of 20 dBuV emf and 60 dBuV emf at the nominal frequency of the receiver to be applied to the receiver input successively. The signal should initially have normal test modulation and the voice output terminal power should be set to the nominal output level. The normal test modulation should then be replaced by amplitude modulation to 30% with a 1000 Hz tone. The audio power should again be measured. It may be necessary to make this measurement with a selective voltmeter.

2.3.9 Audio frequency response

Definition:

B&W 4000

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B&W 4000

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The audio frequency response of the receiver expresses the variation in the audio-power at the line output terminal as a function of the modulation frequency of the input signal.

Method of measurement:

A test signal at a level of 60 dBuV emf at the nominal frequency of the receiver and having normal test modulation to be applied to the receiver input.

The audio power to be adjusted to 50 % of the rated output power. This setting is not to be altered during the test.

The frequency deviation at 1000 Hz then should be reduced to $(+/-)0,5$ kHz and maintained constant while the modulation frequency is varied at least between 300 Hz and 5000 Hz.

The measurement is repeated with the test signal successively at plus and minus 1,25 kHz from the nominal frequency of the receiver.

2.3.10 Harmonic distortion**Definition:**

The harmonic distortion factor at the voice output terminal of the receiver is defined as the ratio, expressed as a percentage, of the r.m.s. voltage of all the harmonic components of the fundamental audio frequency to the total r.m.s. output voltage.

With the method of measurement described below in case a distortion meter is used, the hum and noise components are included in the distortion measurement.

Method of measurement:

Test signals of 60 dBuV emf and 100 dBuV emf at the nominal frequency of the receiver should be applied successively to the receiver input.

In each measurement the audio power at the voice output terminal should be adjusted to the nominal output level.

The test signal to be modulated successively with 300, 500 and 1000 Hz tones to $(+/-)1,5$ kHz frequency deviation and the harmonic distortion is measured at each frequency.

Under extreme test conditions, tests to be carried out at the nominal frequency of the receiver as well as at plus

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and minus 1,25 kHz from the nominal frequency. In this case the input signal is modulated only with a 1000 Hz tone to a frequency deviation of (+)(-) 1,5 kHz.

2.3.11 Noise and hum

Definition:

The "noise and hum" of the receiver is the ratio, expressed in decibels, of the audio frequency noise and hum level resulting from the spurious effects of the power supply system or from other causes to the audio frequency level produced by RF-signals as specified below and applied to the receiver input.

Method of measurement:

- a) A test signal at a level of 30 dBuV emf at the nominal frequency of the receiver and having normal test modulation should be applied to the receiver input. A psophometric filter to be connected at the voice output terminal. The audio power to be adjusted to nominal level.

The output voltage is measured with an r.m.s. voltmeter.

The modulation is then removed and the audio power measurement is repeated.

- b) The same method as in case a) above, but without the psophometric filter and using a peak-to-peak voltmeter for the measurement.

2.3.12 Audio output due to vibration

Definition:

Audio output due to vibration denotes the ability of the receiver to withstand influence on a received radio frequency signal by mechanical vibrations.

Method of measurement:

The noise and hum of the receiver is measured in accordance with 5.3.6. The receiver should during the test be vibrated in each of 3 directions.

10 - 100 Hz 1 m/s²

sweep rate 1 octave per minute

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During the vibration the radio frequency test signal should be unmodulated and the level of the receiver output signal should be measured.

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2.4 MEASUREMENT ACCURACY																																		
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REQUIREMENT SPECIFICATION

Levernare - Prepared ET/SYS PES	Fachabteilung - Design responsible ET/SYS PES	No. Nr. 1056 - A 296 5175/3 Us
Dokument-Code-Nr.: Dokument-Nr.: ET/SYSC STT STT		Datum-Dress Rev. Fd. Fdr. 1990-02-23 A MTS19.3
<p align="center">Cantel Mobitex</p> <p align="center">Beschreibung</p> <p align="center">MOBITEX</p> <p align="center">Other interfaces, mobile terminal and fixed terminal</p>		

ABSTRACT

This document specifies the interfaces between the MOBITEX network and a mobile or fixed terminal connected to the network.

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APPENDIX A: Mobitex ASynchronous Communication, Commands.

APPENDIX B: Application example of how to connect fixed terminals via MCU.

APPENDIX C: Mobile terminal monitoring channels, other than MOBITEX, for special purposes(1200 Bps terminals only).

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1 INTRODUCTION

1.1 GENERAL

The purpose of this specification is to give well defined interfaces for the connection of application equipment. This specification will serve as a recommendation for the mobile terminal market.

NOTE: The Radio/MCU must be type-tested with a terminal of "masc" type. A minimum number of commands (defined by document Mobitex ASynchronous Communication, APPENDIX A, Commands) are then required.

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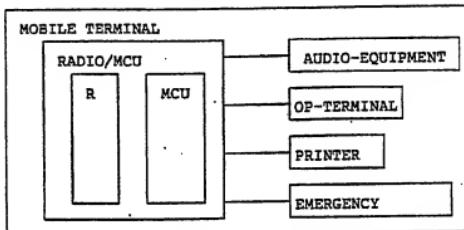
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2 GENERAL DESCRIPTION

The picture below shows the mobile terminal system parts.



MOBILE TERMINAL : complete equipment
MCU : mobile control unit
AUDIO-EQUIPMENT : equipment like mic/speaker, handset
OP-TERMINAL : terminal for operators
EMERGENCY EQU. : equipment like emergency receiver, emergency button

2.1 Terminal interface

Asynchronous, serial data transmission. Permitted transmission rates are 600, 1200, 2400, 4800 and 9600 Baud. However, for "masc" type terminals 600 baud is not permitted. Default value is 1200 Baud. In MCU it must be possible to set any of these baud rates by hardware switches or alike. It must be possible to set the baud rate of each output separately. Normally 1 start bit, 8 data bits, 1 stop bit and no parity is used. However, masc type terminals should use 7 data bits and even parity.

2.1.1 Printer/data collection unit

Interface designed to connect a printer or any other character (text) oriented terminal. It can also be used for data collection units. This interface must be combined with one or more of the other terminal interfaces. The 7 most significant bits are coded according to MOBITEX TEXT CODE, see reference RL-06. The eighth bit is set to logical zero.

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2.1.2 Terminal with small display

Designed for connection to a unit with a limited text display area and from which the operator can enter numbers, status messages and text including simple text editing. The editor is placed in MCU. Also the audio equipment and the manual mode of the radio equipment can be handled from this unit. Character oriented format (as above) is used.

2.1.3 ANSI terminal

For connection of asynchronous full screen terminal which complies with terminal interface ANSI X 3.41 1964 and ANSI X 3.64 1979 with respect to cursor control and editing functions.

From the terminal the operator can enter numbers, status messages and text including text editing. The editor is placed in MCU. Character oriented format as above.

2.1.4 "MASC" type terminal

Connection of units with the capacity to handle complete data packets (MPAK), e.g. a personal computer. The format is block oriented which means that information is transmitted in the form of packets (MPAK) according to the format which is given in the network layer specification. Control of the complete mobile terminal, e.g. audio equipment and manual mode, is performed by special commands included in the protocol. The interface also contains functions for reading status parameters in the mobile terminal (meant for the type test). 7 bits per character and even parity to be used. Permitted transmission rates are 1200, 2400, 4800 or 9600 Baud.

For type testing, a masc type interface is required. In this case it may be implemented by external adaptors.

2.2 Audio interface

Connection of microphone and loudspeaker or handset. The interface also contains certain control functions. The handset can be combined with numeric and status keys. The same character codes as for the terminal with small display are used. The audio interface can also be combined with the terminal interface. Refer also to the application examples.

2.3 Emergency interface

Connection facilities for four units. Three connections are for emergency buttons and one is for a receiver for receiving emergency transmissions generated by a portable transmitter. Any of these units can initiate the emergency procedure in MCU.

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3 TERMINAL INTERFACE

This chapter describes the interface to equipment which communicates with MCU in serial form.

3.1 PHYSICAL INTERFACE

The physical interface is the same for all terminal types.

The terminal interface uses a 25-pole DSUB socket (female socket with pins) with the following configuration:

PIN	V.24/V.28	V.10 category 1/V.11	SOURCE
1	supply ground	supply ground	
2	transmitted data	transmitted data	A DTE
3	received data	received data	A MCU
4	*	*	
5	*	*	
6	data set ready	data set ready	A MCU
7	signal ground	signal ground	
8	*	data terminal ready	B DTE
9	system start (ground)	system start (ground)	DTE
10	system start (+12V)	system start (+5V)	DTE
11	*	*	
12	*	*	
13	*	*	
14	*	transmitted data	B DTE
15	*	received data	B MCU
16	*	*	
17	*	*	
18	*	data set ready	B MCU
19	*	*	
20	data terminal ready	data terminal ready	A DTE
21	*	*	
22	ring ind.	ring ind.	MCU
23	*	*	
24	-12V (supply)	*	MCU
25	+12V (supply)	+5V (supply)	MCU

* = reserved

Note: Pins 9, 24 and 25 differ from V.28. Pins 9, 10, 24 and 25 differ from V.24.

The following applies to V10: 0 or ON is when A > B and 1 or OFF is when B > A.

The following applies to V28: 0 or ON is when V > 3V and 1 or OFF is when V < -3V.

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Pin:

- 2,3 The transmission rate for serial data is 600, 1200, 2400, 4800 or 9600 baud.
- 6 The signal "DATA SET READY" is activated as soon as MCU is ready to transmit. The signal to be activated when it is not used.
 An active signal means that the physical layer is in the data transmission mode.
- 9 System Start, activating MCU from equipment not according to V.28.
 MCU starts up within 10 seconds when pin 9 is activated (ON condition). MCU then remains on until all system start signals are inactivated.
 ON condition: voltage 0V - +1V; current less than 5 mA.
 OFF-condition: not connected or voltage +2V - +15V; current less than 5 mA.
- 10 System Start, activating MCU by signal according to V.28.
 MCU starts up within 10 seconds when pin 10 is activated. MCU then remains on until all system start signals are inactivated.
 ON condition: voltage > 3V (see V28).
 OFF condition: not connected or voltage < -3V. (see V28).
- 20 The signal "DATA TERMINAL READY" is activated as soon as the terminal is ready to receive. The signal is to be activated when not used.
 An active signal means that the physical layer is in the datatransmission mode.
- 22 The signal "RING INDICATION" is used to activate the periferal unit.
- 24 - 12 V/100 mA supply for connected equipment.
- 25 + 12 V (+ 5 V)/500 mA supply for connected equipment.

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3.2 PROTOCOL FOR PRINTER/DATA COLLECTION UNITSGeneral

Interface designed to connect a printer or any other character (text) oriented terminal. It can also be used for data collection units. This interface must be combined with one or more of the other terminal interfaces.

Receiving text

To stop the data stream from MCU temporarily, the printer sends XOFF (DC3) to MCU and to restart the data stream it sends XON (DC1).

Sending text

Text can be sent to MCU. In MCU a complete MPAK will be created with sender and addressee before it is transmitted on the radio path.

The connected unit stops sending when it has received XOFF (DC3) from MCU and does not start again until XON (DC1) is received.

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3.3 PROTOCOL FOR TERMINALS WITH SMALL DISPLAY**3.3.1 Receiving data**

To stop the data stream from MCU temporarily , the terminal sends XOFF (DC3) and to restart the data stream it sends XON (DC1). Received characters in the code range 32 - 126 (decimal) are printed out directly. Other codes are interpreted by the terminal according to the following table:

CHARACTER CODE	TERMINAL'S INTERPRETATION OF CHARACTER
000	NUL
001	SOH
002	STX
003	ETX
004	EOT
005	ENQ
006	ACK
007	BEL
008	BS
009	HT
010	LF
011	VT
012	FF
013	CR
014	SO
015	SI
016	DLE
017	DC1
018	DC2
019	DC3
020	DC4
021	NAK
022	SYN
023	ETB
024	CAN
025	EM
026	SUB
027	ESC
028	FS
029	GS
030	RS
031	US
127	DEL

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SEQUENCE	FUNCTION WHEN RECEIVED
<ESC>[Ax	place the cursor at position x
<ESC>[Bx	insert character x at cursor position
<ESC>[Cx	delete character at cursor and insert
<ESC>[Dx	character x at end of line
<ESC>[Ex	delete character at cursor and insert
<ESC>[H	character x at beginning of line
<ESC>[M	send user information
<ESC>[N	send display size
<ESC>[O	restart of terminal from MCU
<ESC>[P	display visible <CR>
<ESC>[Q	display visible <LF>
<ESC>[R	
<ESC>[S	LED1: on (contact with system)
<ESC>[T	(green) blinking (no contact with system)
<ESC>[U	off (power off)
<ESC>[V	LED2: on (external call ind. on)
<ESC>[W	(orange) blinking (no function)
<ESC>[X	off (external call ind. off)
<ESC>[Y	LED3: on (Manual radio mode)
<ESC>[Z	(yellow) blinking (Call indication man. mode)
<ESC>[{	off (MOBITEX)

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3.3.2 Sending data

The terminal stops when it has received XOFF (DC3) from MCU and does not restart until XON (DC1) is received. All characters are interpreted as when receiving except for the <ESC> sequences defined in the following table:

SEQUENCE	FUNCTION WHEN SENDING
<ESC>OA	place cursor at beginning of text
<ESC>OB	place cursor at end of text
<ESC>OC	move cursor one step to the right
<ESC>OD	move cursor one step to the left
<ESC>OE	user information follows (2048 octets)
<ESC>OBxy	display size: x=character/line, y=no. of line
<ESC>OK	user information missing
<ESC>OM	send message
<ESC>OP	LINE CONNECTION start
<ESC>OQ	STATUS
<ESC>OR	EMERGENCY
<ESC>OW	TELEX
<ESC>OX	DATEX
<ESC>Ol	copy
<ESC>Om	lock
<ESC>On	LINE CONNECTION end
<ESC>Oo	external call indication on/off (toggle).
<ESC>Op	TEXT
<ESC>Oq	increase audio volume
<ESC>Or	decrease audio volume
<ESC>Os	loudspeaker on/off (toggle)
<ESC>Ot	cancel
<ESC>Ou	TELEPHONE
<ESC>Ov	MANUAL RADIO MODE

When the terminal is sending, the character DEL (decimal 127) is interpreted as the terminal wishing to remove the character to the left of the cursor.

Following ASCII codes are used to control MANUAL RADIO mode:

Q	channel number where x=channel number 01 - 99
W X	squelch on/off (toggle)
E	selective call to xxxxxxxx, x = 0 - 9
R xxxxxxx	transmit call tone
T	loudspeaker on/off (toggle)
Y	scanning
U	external call indication on/off (toggle)
I	

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3.4 PROTOCOL FOR ANSI TERMINAL**3.4.1 Receiving data**

To stop the data stream from MCU temporarily, the ANSI terminal sends XOFF (DC3) and to restart the data stream it sends XON (DC1). Received characters in the code range 32 - 126 (decimal) are displayed directly. Other codes are interpreted by the ANSI terminal according to the following tables:

CHARACTER CODE	ANSI terminal's interpretation of character
000	NUL
001	SOH
002	STX
003	ETX
004	EOT
005	ENQ
006	ACK
007	BEL give audible signal
008	BS move cursor one step to the left
009	HT
010	LF line feed
011	VT
012	FF
013	CR carriage return
014	SO
015	SI
016	DLE
017	DC1 resume sending data
018	DC2
019	DC3 stop sending data
020	DC4
021	NAK
022	SYN
023	ETB
024	CAN
025	EM
026	SUB
027	ESC carry out function as defined below
028	FS
029	GS
030	RS
031	US

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SEQUENCE	FUNCTION WHEN RECEIVING	
<ESC>[A	cursor up	one step
<ESC>[B	cursor down	one step
<ESC>[C	cursor right	one step
<ESC>[D	cursor left	one step
<ESC>[c	restart of terminal from MCU	
<ESC>[0q	switch off LED1--LED4	(not ANSI)
<ESC>[1q	switch on LED1	(not ANSI)
<ESC>[2q	switch on LED2	(not ANSI)
<ESC>[3q	switch on LED3	(not ANSI)
<ESC>[4q	switch on LED4	(not ANSI)

For the meaning of LED1 - LED3 see terminal with small display.

If additional functions are required, we recommend the use of functions and control sequences in accordance with ANSI X 3.41 1974 and ANSI X 3.64 1979...

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3.4.2 Sending data

The ANSI terminal stops sending when it has received XOFF (DC3) from MCU and does not restart until XON (DC1) is received. All characters are interpreted as when receiving, except for the <ESC> sequences defined in the following table:

SEQUENCE	FUNCTION WHEN SENDING
<ESC>OA	move cursor up one step
<ESC>OB	move cursor down one step
<ESC>OC	move cursor one step to the right
<ESC>OD	move cursor one step to the left
<ESC>OE	-
<ESC>OF	-
<ESC>OG	display size: x=character/line,y=no. of lines
<ESC>OHxy	-
<ESC>OI	-
<ESC>OJ	-
<ESC>OK	user information missing
<ESC>OL	-
<ESC>OM	send message
<ESC>ON	-
<ESC>OO	-
<ESC>OP	LINE CONNECTION start
<ESC>OQ	STATUS
<ESC>OR	EMERGENCY
<ESC>OS	-
<ESC>OT	-
<ESC>OU	-
<ESC>OV	-
<ESC>OW	TELEX (not in ANSI standard)
<ESC>OX	DATEX (not in ANSI standard)
<ESC>OY	-
<ESC>OZ	-
<ESC>O[-
<ESC>O\	-
<ESC>O]	-

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SEQUENCE	FUNCTION WHEN SENDING
<ESC>0a	-
<ESC>0b	-
<ESC>0c	-
<ESC>0d	-
<ESC>0e	-
<ESC>0f	-
<ESC>0g	-
<ESC>0h	-
<ESC>0i	-
<ESC>0j	-
<ESC>0k	-
<ESC>0l	copy
<ESC>0m	lock
<ESC>0n	LINE CONNECTION end
<ESC>0o	external call indication on/off (toggle)
<ESC>0p	MOBITEX, start sending message
<ESC>0q	increase volume
<ESC>0r	decrease volume
<ESC>0s	loudspeaker on/off
<ESC>0t	cancel
<ESC>0u	TELEPHONE
<ESC>0v	scroll up presentation field
<ESC>0w	scroll down presentation field
<ESC>0x	get next message
<ESC>0y	-
<ESC>0z	-
<ESC>0{	-
<ESC>0	-
<ESC>0}	-

When the terminal is sending the character DEL (decimal 127) is interpreted as the terminal wishing to remove the character to the left of the cursor.

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3.5 PROTOCOL FOR "MASC" TYPE TERMINALS

The masc type interface is designed for connection of units with the capacity to handle complete data packets (MPAK see reference RI-09), e.g. a personal computer. Information is transferred between the terminal and MCU in the form of frames, described in subsequent clauses. Control of the complete mobile terminal, e.g. audio equipment and manual mode, is performed by special commands included in the protocol. The interface also contains functions for reading status parameters in the mobile terminal (meant for the type test).

For type testing, a masc type interface is required. In this case it may be implemented by external adaptors. For the type testing, only the basic commands and the type testing commands are required.

A frame is formed as a message packet with unique characters marking the beginning and the end of the frame. Sending may be initiated from both sides. The information frame must be acknowledged with ACK before the next information frame is sent.

The characteristics of the protocol are:

- All characters are coded into the 7 least significant bits and bit 8 is used for even parity.
- The error control is done by longitudinal and character parity check and frame length control,
- Transparent data can be sent in hex coded data fields.
- The protocol permits full duplex.

3.5.1 Frame structure

Communication takes place in the form of frames. There are two types of frames, information frames and control frames. The information frames are used to transfer commands and other information. The control frames are used to control the information frame flow.

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The Information frames are divided into the following fields
 (number of octets stated below):

start	length	text	std.	data	check	end
1	4	1-256	1	0-1120	2	1

The Control frames are divided into the following fields
 (number of octets stated below):

start	type	sequ	end
1	1	0-1	1

The maximum frame size permitted is set up by the B-command.
 The maximum possible size is 1150 octets. This means that an
 Information frame can not have the maximum length in all
 fields.

- Start

The start of a frame is denoted by the character ^ with code
 136/94/5E in octal/decimal/hexadecimal notation.

All characters received before the start character should be
 ignored. Every start character is the beginning of a new frame.

- Length

The size of the frame, in number of octets, should be written
 in this field with the ASCII codes of four hexadecimal digits.
 The least significant digit should always be written in octet
 4.

The size of the frame includes all octets including start and
 end characters.

Permitted characters of length field: 0-9, A-F.

- Text

Text is a field which determines the meaning and the
 interpretation of the frame. The interpretation of the text
 field is carried out by a higher layer. The text field consists
 of at least 1 character and a maximum of 256 characters.
 Numeric information, e.g. command parameters, are always to be
 given as the ASCII codes of the corresponding hexadecimal
 digits 0-F.

Permitted characters of text field are:
 SPACE (40/32/20) to } (175/125/7D) except Std(:) and
 startcharacter('').

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- Std (start data)

Text and data are separated by the character : (colon 72/58/3A). Std should be stated even if the data field is empty.

- Data

The data field consists of data. The coding of the data field is carried out in hexadecimal code so that transparent data can be sent. Each octet of data which is to be coded into the data field is divided into two half octets with four bits in each. Each of these four bit groups is then represented in the data field by the ASCII code of the corresponding hexadecimal digit 0-F. Thus each input octet is represented by two characters (octets) in the data field.

The data field consists of maximum 1120 characters. Permitted characters of data field is: 0-9, A-F.

- Check

Longitudinal checksum created by exclusive OR on all characters starting with the start character and ending with the character before the checkfield. The check field consists of two ASCII coded hexadecimal digits with the least significant digit in octet 2.

Permitted characters for the check field is: 0-9, A-F

- Type

The type of control frame is stated with one character. The characters which may be used are * (52/42/2A), ? (77/63/3F), ! (41/33/21), # (43/35/23) or & (46/38/26).

- Sequ (sequence number)

The sequence number for ACK-frames. The sequence number can be one of the characters 0 (60/48/30), 1 (61/49/31) or - (minus, 55/45/2D).

- End

The frame is terminated with the carriage return character (CR, 15/13/0D). A frame which is not ended with the end character should be ignored.

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Rapport

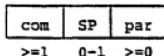
Cantel Mobitex

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Datum 3ax	1990-02-23 A MTS19.3

3.5.2 Information frame

Messages are sent as Information frames with an expected acknowledgement (ACK).

The text field of an Information frame has the following general structure:



com is the command or function code.

SP is the space character (ASCII code 40/32/20 in octal/decimal/hexadecimal notation) which separates the command from the parameters.

par is the ASCII coded parameters or data.

A command which sets parameter A to 587 can be coded in the following ways (all commands are terminated with CR):

^0010S A=587:50	
^0012SET A/587:D1	
^0010S A:028BAF	028B is hex code for 587
^000FSA:028B78	SA is a command

Note: The textfield can only consist of one (1) command.

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3.5.3 Control frames

The protocol consists of the following control frames:

- ACK
- NACK
- RACK
- SENS
- SACK

- ACK (Acknowledgement of a correct received frame)

Structure:

^	*	'sequ'	CR
1	1	1	1

ACK means that the received Information frame is correct. A correct frame should comply with the following:

- starts with the start character (^)
- contains only one colon (:)
- the fields "check" and "length" have the correct values
- only permitted characters in text and data fields
- no characters with parity error
- the permitted number of characters has not been exceeded in any individual field or in the complete frame.
- ends with the end character (CR)

The field "sequ" (sequence number) should alter between ASCII character 0 and ASCII character 1 for each frame sent, except when repeating the latest ACK on a RACK request. Then the same value as before is sent again.

The first time an ACK is sent "sequ" should be the character 0. If a RACK is received before any ACK has been sent, the field "sequ" will be filled with the character - (minus). "Sequ" with the value of - (minus) is only used when RACK is received before ACK has been sent the first time.

- NACK (No acknowledgement of an incorrect received frame)

Structure:

^	?	CR
1	1	1

NACK is to be sent if the conditions for sending ACK are not fulfilled and the Information frame:

- starts with the start character (^)
- contains only one colon (:)
- has a total length of 10 characters or more
- ends with the end character (CR)

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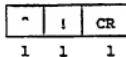
Nr Nr	1056 - A 296 5175/3 Ue
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Should the criteria not be fulfilled for sending ACK or NACK, no reply will be given. The frame will then be repeated by the timeout function in the sending unit.

If the receiving unit cannot handle the incoming data flow, NACK may be used to limit the flow.

- RACK (Request for repetition of the latest sent ACK).

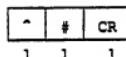
Structure:



RACK, request for repetition of the latest sent ACK, is sent when no reply on the Information frame has been received within 10 seconds. The receiver of RACK is to reply by repeating ACK with the latest sequence number (sequ) used.

- SENS (link layer control)

Structure:



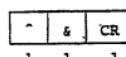
SENS is used to control the communication link when there is no traffic. The sender decides when SENS will be sent. Time between 2 SENS should be at least 10 seconds.

When sending a SENS a reply (SACK) will be received within 10 seconds. If no reply is received within 10 seconds, a new SENS will be sent. When two SENS have been sent and no reply is received or no info-frame has been correctly transmitted, the communication link is supposed to be broken. A restart will be done by sending a B-frame.

If SACK is received and no SENS has been sent, the SACK will be ignored.

- SACK (Sens acknowledgement)

Structure:



SACK will be sent when a controlframe (SENS) has been received. It should be sent at the first possible opportunity when nothing else is being sent.

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3.5.4 Flow control and error handling

If the reply of an Information frame is ACK, the Information frame will be correctly received. The field "sequ" is saved as the latest received sequ number.

If the reply is a NACK, the Information frame will be repeated.

If there is no reply within 10 seconds after the Information frame was sent, a RACK will be sent. If there is no reply on the RACK, a new RACK will be sent every 10 seconds. If no ACK has been received within 30 seconds after the Information frame was sent (time-out), higher layers will be notified. However, the repetition of RACK will continue until interrupted by higher layers or by the fact that an ACK has been received.

When an ACK is received as a reply to a RACK, the sequ number of this ACK will be compared with the stored sequ number of latest received ACK. If the numbers are equal, the Information frame was not received and must be repeated. If the numbers are different, the Information frame was received correctly (but ACK was lost) and the Information frame should not be repeated. However, if the sequ number of the received ACK is - (minus) the Information frame must be repeated.

When the physical layer gets into datatransmission mode the link layer is supposed to start up.

When one of the two interconnected units is started up, it has no stored value of the sequ of the latest received ACK. Neither does it have a value of the sequ of the latest sent ACK. To handle this situation and to prevent a possible doubling of the first frame, the following start up procedure is required:

- The first Information frame sent should be a B-frame. This B-frame consists of communication parameters for masco protocol(see appendix A).
- If the sending of that B-frame leads to error handling with RACK, the B-frame must be repeated regardless of the value of the sequ field of the ACK response to RACK.

The actions to be taken when receiving ACK as a response to RACK are summarized in the following table:

		sequ of received ACK	
		0	1
sequ of the latest received ACK	none	repeat	repeat
	0	repeat	repeat
	1	repeat	no rep.

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Cantel Mobitex		No. No 1056 - A 296 5175/3 Ue
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<p>Communication is on a full duplex line. This means that a message stream can be in progress in both directions at the same time. Both parties may send an Information frame independently of each other and an Information frame may therefore be received when a control frame is expected (ACK/NACK). However, the next incoming frame will then be a reply as each Information frame is to be acknowledged before a new one is sent. The minimum time between these two frames will be the time set by the <u>int</u> (interval) parameter of the B-command (minimum time between the sending of two subsequent frames).</p>		
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3.5.5 Time diagram

0. MCU/terminal starts up by setting protocol parameters.
1. MCU sends Information frame 0 to terminal which sends acknowledge.
2. MCU sends Information frame 1 which is disturbed and then repeated after RACK from terminal.
- 3.0 MCU sends Information frame 2 but it does not reach the terminal the first time. Information frame repeated after RACK and repeated ACK being the same as previous ACK (sequ=0).
- 3.1 The same as 3.0 but this time ACK(1) does not reach the sender. RACK is sent and now the repeated ACK, having a new sequ, indicates that the frame was received correctly.
4. MCU and terminal sending Information frames at the same time.
5. MCU and terminal doesn't start at the same time.
- 5.5 MCU restarts and B-frame is repeated.

(Number in brackets after ACK denotes sequence number)

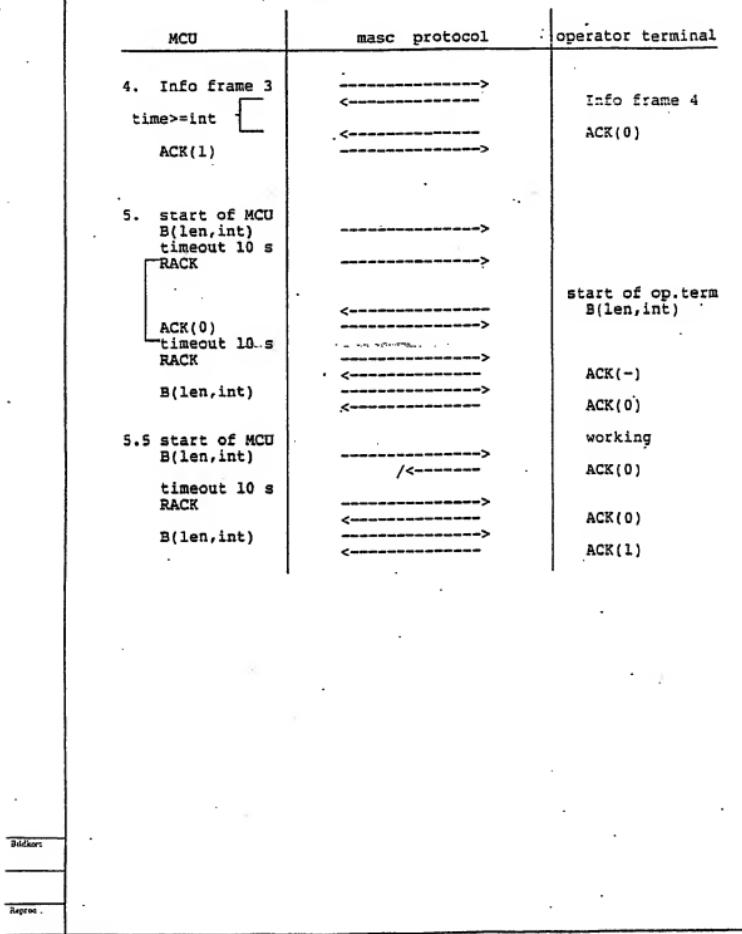
MCU	masc protocol	operator terminal
0. B(len,int)	----->	
	<-----	
ACK(0)	----->	ACK(0) B(len,int)
1. Info frame 0	----->	
	<-----	ACK(1)
2. Info frame 1	-----X----->	NACK
Info frame 1	----->	ACK(0)
3.0 Info frame 2 timeout 10 s	----->/	
RACK	----->	ACK(0)
Info frame 2	----->	ACK(1)
3.1 Info frame 2 timeout 10 s	----->/<-----	ACK(1)
RACK	----->	ACK(1)
 Silent		
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4 AUDIO INTERFACE

This interface is intended for the connection of audio equipment such as microphone and loudspeaker or a handset. The interface also contains certain control functions.

A simple audio equipment can consist of a loudspeaker and a microphone or a handset with holder and switches to activate the functions needed (hook on/off, push-to-talk). The handset can also be a more complex unit using serial data to communicate over the interface and including a small display and numeric and status keys. Some examples, are given in application examples.

4.1 PHYSICAL INTERFACE

The terminal interface uses a 15-pole DSUB socket (female socket with pins) with the following configuration:

PIN	SIGNAL	ACTIVE	SOURCE
1	ground for earphone/loudsp		MCU
2	data send		audio equipment
3	data receive		MCU
4	extern. call indic. on/off	on = 0V	audio equipment
5	volume up	up = 0V	audio equipment
6	volume down	down=0V	audio equipment
7	ground for control signals		MCU
8	system start	start=0V	audio equipment
9	+12V		MCU
10	-12V		MCU
11	microphone LF		audio equipment
12	microphone ground		
13	microphone hook on/off		audio equipment
14	transmit/receive switch	lifted=0V	audio equipment
15	earphone/loudspeaker LF	transm.=0V	audio equipment

pins:

2,3 Data send/receive
V24/V28 applies.
 Data is formatted in accordance with "terminal with small display".

4 External call indication on/off
 When pin 4 is activated, MCU toggles the external call indication on/off. When on, the external call indicator (e.g. horn) is activated when a message is received.

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pins:
5,6

Volume up/down

Grounding pin 5 or 6 will adjust the audio level (volume) of the loudspeaker or the earphone, whichever is active when the pin is activated. (The audio level of the inactive unit will remain as before.) The adjustment is made in steps, one step for each new activation of the pin. If the pin is activated continuously, the level to be adjusted by one step per second. The lowest level possible to set must still be noticeable.

8

System start

MCU will start up within 10 seconds when pin 8 is activated. It then remains on until switched off by other means even if the pin is inactivated.

9,10

Power supply of connected equipment

+12V (pin 9) is able of supply a current of at least 500 mA and -12V (pin 10) a current of at least 100 mA.

11,12

Microphone input

Input impedance: 10 kohm.

Sensitivity: An input signal with the frequency 1 kHz and a level of 100 mV produces an RF deviation of 3.0 kHz. This level is produced by the microphone at a sound pressure of 94 dB above 2×10^{-5} pascal.

13

Microphone hook on/off

When the microphone or handset is lifted from its holder, pin 13 is activated (HOOK_OFF signal generated). If a handset with earphone is used, the loudspeaker will be inactivated and the earphone activated. When the microphone or handset is placed in its holder again, pin 13 will be inactivated (HOOK_ON signal generated). If an earphone has been used, it will be inactivated and the loudspeaker activated (for audio level settings, see pin 5,6).

14

Transmit/receive switch

When activated, the radio unit will transmit and when deactivated, the radio unit will receive (push-to-talk switch).

1,15

Earphone/loudspeaker

This output is able to support impedances down to 4 ohms.

Earphone sensitivity: The earphone produces a sound pressure of 85-95 dB above 2×10^{-5} pascal when driven by a signal with the frequency 1 kHz and a level corresponding to an RF deviation of 3.0 kHz.

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5 EMERGENCY INTERFACE

5.1 PHYSICAL INTERFACE

The terminal interface uses a 15-pole DSUB socket (female socket with pins) with the following configuration:

PIN	SIGNAL	ACTIVE	SOURCE
1	emergency 1	emerg=0V	emergency equip.
2	emergency ACK	ACK =0V	MCU
3	emergency_ack. from fixed	emack=0V	MCU
4	emergency_ack. ACK	ACK =0V	emergency equip.
5	*		
6	emergency 2	emerg=0V	emergency equip.
7	ground for control signal		
8	system start	start=0V	emergency equip.
9	+12V (supply)		MCU
10	*		
11	emergency 3	emerg=0V	emergency equip.
12	emergency 4	emerg=0V	emergency equip.
13	emergency LF input		emergency equip.
14	emergency LF ground.		emergency equip.
15	external indicator	on = 0V	MCU

* = reserved

pins:

1. Emergency 1
 Emergency alarm from an external emergency unit, e.g. a receiver for emergencies sent on radio from a pocket transmitter. Emergency 1 (pin 1) is used together with pin 8 (system start) and pin 2 (emergency ACK from MCU) to be able to initiate an emergency alarm even if MCU is powered off. When the external emergency unit initiates the alarm, it activates both pin 1 (emergency 1) and pin 8 (system start). After detecting the alarm, MCU sends an acknowledgement to the emergency unit by activating pin 2 (emergency ACK from MCU). The emergency unit must keep pins 1 and 8 activated until this ACK has been received.
 MCU will then create and send a SOS packet to the network.

2 Emergency ACK from MCU

Emergency ACK is an acknowledgement from MCU that emergency 1 has been received by MCU (response to activation of pin 1).

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Cantel Mobitex -		Nr. Nr. 1056 - A 296 5175/3 Ue
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3 Emergency acknowledgement from fixed terminal		
<p>When the fixed terminal has received the emergency message (SOSINFO), it can send a special emergency acknowledge packet (SOSACK) or a request for an emergency connection (SOSCONREQ) addressed to the alarming subscription. When a SOSACK is received by MCU, it indicates this to the emergency unit by grounding pin 3. The emergency unit in turn grounds pin 4 as an acknowledgement.</p> <p>Additional reactions from MCU when receiving SOSACK or SOSCONREQ are very much depending on application. A parameter emergency-acknowledge-status should be implemented and stating at least the following:</p> <p>status = 0 no additional reaction 1 activate external indication (e.g. horn) 2 emergency line connection in direction mobile to base (one-way, mobile transmitting) 3 send acknowledge to op. terminal</p>		
4 Emergency acknowledgement ACK from emergency unit		
<p>Used by the emergency unit to acknowledge the activation from MCU of pin 3.</p>		
6,11,12 Emergency 2, 3 and 4		
<p>These pins are intended for initiating an emergency alarm from simple emergency equipment such as a single push button. When one of these pins is activated, MCU creates a SOS packet and sends it to the network. Should the pin remain active, the time between repeated SOS packets must be at least 1 minute. The signals are not acknowledged by MCU.</p>		
8 System start		
<p>MCU will start up within 10 seconds when pin 8 is activated. It then remains on until switched off by other means even if the pin is inactivated.</p>		
9 Power supply for external equipment		
<p>+12V is able to supply a current of at least 500 mA. (The emergency unit should always be powered up)</p>		
13,14 Emergency LF input (for emergency connection)		
<p>Input impedance: 10 kohm. Sensitivity: An input signal with the frequency 1 kHz and a level of 100 mV produces an RF deviation of 3.0 kHz. This level is produced by the microphone at a sound pressure of $94 \text{ dB above } 2 \cdot 10^{-5} \text{ pascal}$.</p>		
15 Activation of external indicator		
<p>This pin is used to activate an external indicator (e.g. horn). It is able to sink at least 100 mA to operate e.g. a relay which activates the horn (open collector output).</p>		

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5.2 Time diagram:**EMERGENCY UNIT (emergency 1):**

packet	radio path	RADIO/MCU	interface	em. unit
SOS	<-----	start emergency 1 emergency ACK send emergency signal (external indicator might be activated)	<--- 8 2 ----> 15 ---->	start up emerg.1 ack (horn)

IN CASE OF MANUAL ACKNOWLEDGE FROM FIXED TERMINAL AFTER RECEIVING SOSINFO

SOSACK	----->	emerg._ack from fixed ----- acc. to em.ack.status (e.g. ext. indicator)	3 ----> -----<---- 4 15 ---->	fixed ack ack (horn)
--------	--------	--	-------------------------------------	----------------------------

EMERGENCY BUTTON (emergency 2, 3 or 4):

packet	radio path	RADIO/MCU	interface	em.but.
SOS	<-----	emergency 2 (3 or 4) send emergency signal (external indicator might be activated)	<--- 6 15 ---->	emerg.2 (horn)

IN CASE OF MANUAL ACKNOWLEDGE FROM FIXED TERMINAL AFTER RECEIVING SOSINFO

SOSACK	----->	emerg._ack from fixed ----- acc. to em.ack.status (e.g. ext. indicator)	3 ---/ 15 ---->	
--------	--------	--	--------------------	--

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6 APPLICATION EXAMPLES

The interfaces can be used in a variety of ways depending on the application. Below are some examples given.

The terminal equipment can be connected to these interfaces.

OP. TERMINAL

terminal interface

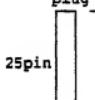
plug



The op. terminal comprises a display for message presentation and editing and a keyboard for entering commands and information.

printer interface

plug



PRINTER

Printer for printing out text or data collection unit sending text strings.

audio interface

plug



AUDIO EQUIPMENT

Loudspeaker and microphone or handset with or without keys. Switches/buttons to control interface signals and/or serial data according to V24/V28.

emergency interface

plug



EMERGENCY EQUIPMENT

Emergency unit, e.g. receiver for emergencies from pocket transmitter, or simple emergency buttons to initiate emergency signal (SOS) from MCU.

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Report

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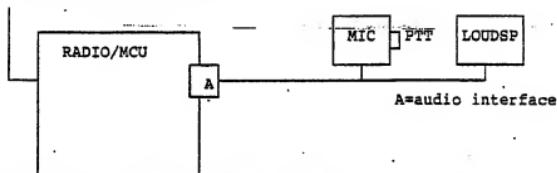
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The following examples are described:

1. Microphone/loudspeaker
2. Handset with numeric and function keys
3. Handset with numeric and function keys, printer
4. Microphone/loudspeaker, control unit, printer
5. Op. terminal with small display, loudspeaker, printer
6. Op. terminal of ANSI type, microphone/loudspeaker, data collection unit
7. PC, microphone/loudspeaker
8. PC, handset with keys, printer, emergency equipment
9. PC, microphone/loudspeaker, control unit, printer, emergency equipment

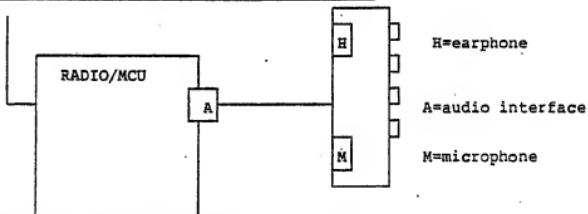
(PTT = push-to-talk button)

1. Microphone/loudspeaker



Is able to send/receive speech. (Sends only to default receiver)

2. Handset with numeric and function keys



Is able to send/receive status and speech.

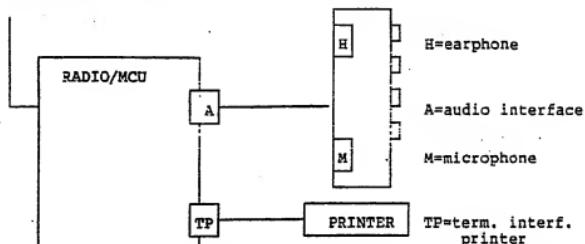
Builders

Reproc

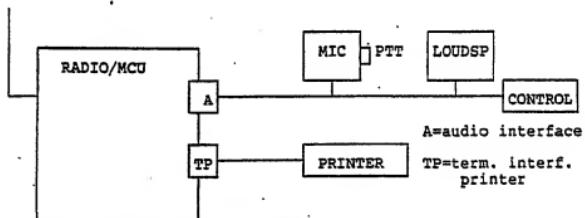
A 296 5175/3

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3. Handset with numeric and function keys, printer

Is able to send/receive status and speech and to receive text.

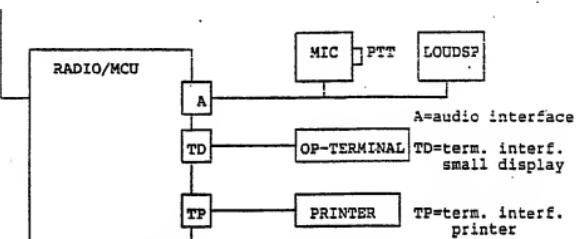
4. Microphone/loudspeaker, control unit, printer

Is able to send/receive status and speech and to receive text.

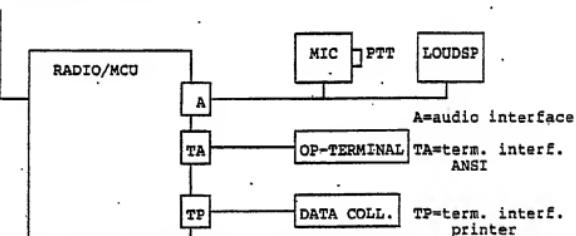
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Replies

A 296 5175/3

Cantel MobitexNr. 1056 - A 296 5175/3 Ue
Sprint Date 1990-02-23 | Rev. A | File MTS19.35. Op. terminal with small display, microphone/loudspeaker, printer

Is able to send/receive text, status and speech.

6. Op. terminal of ANSI type, microphone/loudspeaker, data collection unit.

Is able to send/receive text, data, status and speech. Data can be controlled and collected over radio in the form of text strings to and from the data collection unit.

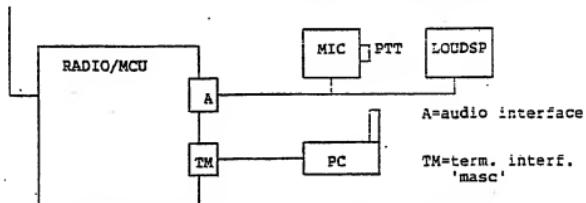
Bildort

Report

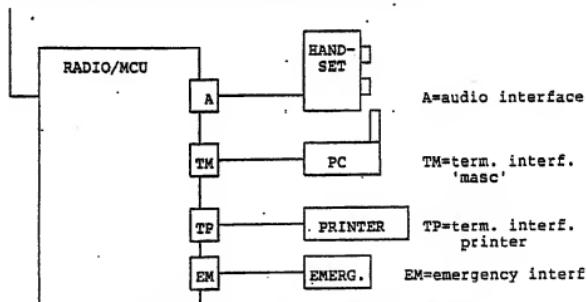
A 296 5175/3

Cantel Mobitex-

Ref. No. 1056 - A 296 5175/3 Ue
Datum Date 1990-02-23 Rev. A
Fc. File MTS19.3

7. Personal computer as terminal, microphone/loudspeaker

Is able to send/receive text, data, status and speech.

8. Personal computer as terminal, handset with numeric and function keys, printer, emergency equipment

Is able to send/receive text, data, status, speech and emergency.

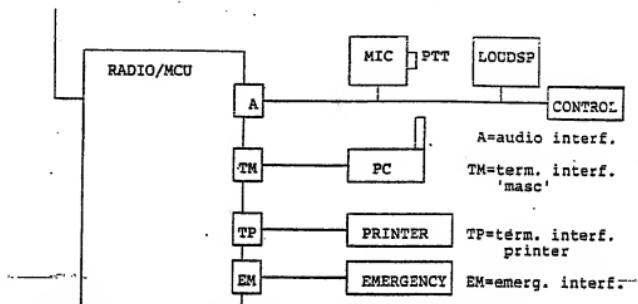
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A 296 5175/3

Cantel Mobitex

Nr. Nr.
1056 - A 296 5175/3 Ue
Datum Date 1990-02-23 IFC F. A MTS19.3

9. Personal computer as terminal, microphone/loudspeaker, control unit, printer, emergency equipment

Is able to send/receive text, data, status, speech and emergency.

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A 296 5175/3

Cantel Mobitex-

Mr. No.	1056 - A 296 5175/3 Ue
Design. Date	Rev. MTS19.3

7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RI-06, 4
RI-09, 16

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RI-01	Arrangement of the documents
RI-02	MOBITEX System description
RI-03	General description of terminals
RI-04	Terminology
RI-05	References
RI-06	Network operator information
RI-08	Application layer
RI-09	Network layer
RI-11	Interface requirements, fixed terminals
RI-12	Other requirements, fixed terminals
RI-16	Link layer, mobile terminals
RI-17	Physical layer, mobile terminals
RI-18	Radio equipment, mobile terminals
RI-19	Other interfaces, mobile terminals
RI-20	Other requirements, mobile terminals

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REQUIREMENT SPECIFICATION

REQUIREMENT SPECIFICATION - (47)			
Uppgård Preparer ET/SYS PES	Förhandsrecension - Director responsible ET/SYS PES	Nr No 2/1056 - A 296 5175/2 Ue	
Dokument/Contract - Document/Contract ET/SYSC STT STI		Datum Date 1990-02-26	V. F.d. A MTS19A.2
Bemärkning	Tid MOBITEX Terminal Specification Mobiter ASynchronous Communication APPENDIX A, Commands		
Cantel Mobitex™			

Cantel Mobitex	Nr. Nr. 2/1056 - A 296 5175/2 Ue <small>Print Date 1990-02-26 A MTS19A.2</small>
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1 INFORMATION FRAME COMMANDS AND FUNCTIONS IN MOBILE TERMINAL

The commands, questions and replies available as information frames in MASC are summarized below and a description is given on the following pages.

1.1 BASIC FUNCTIONS

The following commands are always to be implemented in MCU.

- B parameters for the MASC protocol
- M send/receive MPAK via radio
- E error command or function
- N return of MPAK that has not been sent
- R return of incorrect MPAK
- D route received MPAKs to an output
- S send MPAK to the specified output
- T request or transfer of emergency text
- U send emergency signal (SOS-packet)
- F P terminal subscription MAN request and answer
- F Q device handling the MASC protocol
- F F MCU in contact with Mobitex network
- F G MCU has no contact with Mobitex network
- F H MCU inform that MPAK has been sent over the radio
- F K Error message from MCU
- F O Prepare to close down MCU
- F # Short number list request and answer

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1.2 TYPE TEST FUNCTIONS

The following commands are always to be implemented in MCU.

These functions should only be used during type testing and must be made inoperative for normal use.

All requested parameters which are available in the mobile should be included in all answers to type test functions.

Type test functions consist of commands belonging to specific radio protocol.

To separate mobile terminals with different radio protocol, the following commands are available:

- | | |
|------------|--------------------------------------|
| P-command | Used in mobile terminal at 1200bps. |
| K-command | Used in mobile terminal at 1200bps. |
| PA-command | Used in mobile terminal at 8/16kbps. |
| KA-command | Used in mobile terminal at 8/16bps. |

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1.3 TERMINAL SYSTEM FUNCTIONS

The following commands to be implemented in MCU, according to application.

F system control

1.4 AUDIO FUNCTIONS

The following commands to be implemented in MCU, according to application.

A controlling audio functions

1.5 MANUAL RADIO FUNCTIONS

The following commands to be implemented in MCU, according to application.

H controlling manual radio mode

1.6 USER COMMANDS

The following commands are free to use in applications.
If used in application, contact mobile manufacturer about implementation in MCU.

X

Y

Z

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Series Date	1 Rev 1990-02-26 A MTS19A.2

2 BASIC FUNCTIONS (always to be implemented in MCU)**2.1 B-command (parameters for the MASC protocol)**

Structure of text field:

B	SP	len	,	int
1	1	3	1	1-4

The data field is empty.

The B-command is used to set parameters for the protocol.

len is a 3-digit ASCII coded hex number which sets the maximum length of an Information frame. This field should always be set to the maximum possible frame size, i.e. 47E (1150 decimal).

int is a maximum 4-digit ASCII coded hex number which sets the shortest time between two subsequent frames. The value is given in 10 ms increments. Default value is int = 0.

len and int are separated by a , (comma).

These parameters should be used as soon as they have been received.

The default values are used until a B-command has been received. A B-command should be the first frame sent after start up.

After receiving a B-command, the protocol should send a start of line signal to a higher protocol, to make clear that the connection is established and that the start sequence can follow.

Start_of_line signal is an internal signal between the link layer and higher layer.

Blockers

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2.2 M-command (send/receive MPAK via radio)

Structure of text field:

M	SP	sequ-id
---	----	---------

SP indicate that a sequence number identity is added. If no SP then there is no sequ-id.

sequ-id is a 1-digit ASCII coded decimal number between 0 - 9. This sequence number is an identity of the MPAK.

Structure of data field:

-----	MPAK	-----
-----	16-1120	-----

MCU receiving the M-command sends MPAK via the radio path to the network. If M-command consists of a sequence number, the command FH indicating 'sent to mobitex network' is sent to terminal including the sequence number. Returned MPAK should also indicate sequence number.

MPAK received via the radio path, is sent over the interface to the terminal with the M-command (MAN is included in MPAK). The sequence number is not used in this M-command.

The received MPAK(to be sent via the radio path) should be a permitted MPAK concerning valid information in the MPAK head and MPAK length(sender, trafstate, class, packet type, size of MPAK).

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

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2.3 E-command (Error command or function)**Structure of text field:**

E
1

The datafield may be used to send information about the error.

The E-command informs that the previously received command or function cannot be executed. (Command or function is not implemented in the receiving unit or included parameters are not accepted).

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2.4 N-command (return of MPAK not sent)

Structure of text field:

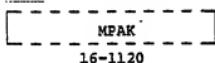
N	SP	err-code	,	sequ-id
1	1	2	1	1

SP indicate that an error code and sequence number are added. If no SP then there is no error code or sequence number.

err-code is a 2-digit ASCII coded hex number between 00 - FF. This error code is described in chapter "Fault situation in mobitex mobile stations".

sequ-id is a 1-digit ASCII coded decimal number between 0 - 9. This sequence number is an identity of the MPAK.

Structure of data field:



The N-command indicates to the terminal that the MPAK has not been sent over radio (communication failure or transmission interrupted by FO or FI-command).

In manual mode MPAK's should be returned by the N-command.

The MCU can indicate the reason, of not sending the MPAK over the radio, by adding the error code.

If a sequence number is indicated in the N-command, then this sequence number should also be in the N-frame.

If no error code or sequence number is valid, this parameter is not added.

Description of the different MPAKs can be found in "Network layer for terminals", see reference R1-09.

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2.5 R-command (return of incorrect MPAK)

When receiving the R-frame and not finding the fault, the receiving unit is supposed to make a restart by sending a B-frame.

Structure of text field:

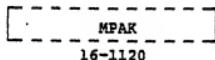
R	SP	err-code	,	sequ-id
---	----	----------	---	---------

SP indicate that an error code and sequence number are added. If no SP then there is no error code or sequence number.

err-code is a 2-digit ASCII coded hex number between 00 - FF. This error code is described in chapter "Fault situation in mobitex mobile stations".

sequ-id is a 1-digit ASCII coded decimal number between 0 - 9. This sequence number is an identity of the MPAK.

Structure of data field:



MCU uses the R-frame to return an MPAK which was received with the M-command and which does not comply with the format and the rules set by the network and link layers of MOBITEX terminals.

The MCU can indicate the reason, of not accepting the MPAK, by adding the error code.

If a sequence number is indicated in the M-command, then this sequence number should also be in the N-frame.

If no error code or sequence number is valid, this parameter is not added.

Description of the different MPAKs can be found in " Network layer for terminals", see reference R1-09.

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2.6 D-command (route received MPAKs to an output)**Structure of text field:**

D	SP	MAN	,	UTG	,	TYP	,	SET
1	1	6	1	1	1	1	1	1

The data field is empty.

MAN is a 6-digit ASCII coded hex number stating the MAN for which MPAKs are to be routed to output UTG. MAN must be one of the possible MANs of the terminal (terminal MAN, group MAN or personal MAN).

UTG is a 1-digit ASCII-coded hex-number stating the output to which received MPAKs are to be routed.

TYP is a 1-digit ASCII-coded hex-number stating the type of MPAK which is to be routed to UTG.

SET is activating the function of set/reset these parameters.

UTG and **TYP** to be used as follows:

UTG = 0 default output
 1 printer
 2 audio
 3 emergency
 4 op. terminal:1 (MASC protocol)
 5 op. terminal:2
 6 op. terminal:3
 7 op. terminal:4
 8 op. terminal:5
 9 op. terminal:6

TYP = 0 no types(reset all)
 1 text
 2 data
 3 status
 4 line connection (speech)
 5 emergency
 6 all types except emergency
 7 extpak
 8 hodata
 9 dteserv

SET = 0 set these parameters
 1 reset these parameters

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After receiving the D-command, MCU will route incoming MPAKs of the specified type and intended for the specified MAN to the function block which handles the communication (formatting etc) for the specified output. Thus it is possible to route MPAKs to several outputs e.g. to both printer and op.terminal.

When receiving a D-command with UTG="default output", the MCU resets all earlier D-commands for the specified MAN and specified TYP. If for example the TYP is "all types", all earlier D-commands concerning this specified MAN are reset and all types are sent to default output connection. If TYP is "no types", then all types is reset for this MAN and UTG.

It is possible to set or reset an earlier D-command, using the parameter set or reset.

After logout, a personal subscription should be removed from this list of routing MPAKs.

When power on, MCU sets up default outputs, e.g. text, data and status to op.terminal and line connection to audio interface.

All MPAK:DTESERV is routed to output, where terminal MAN is located(can be more than one).

Description of the different MPAKs can be found in " Network layer for terminals", see reference RI-09.

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2.7 S-command (sends MPAK to the specified output)

Structure of text field:

S	SP	UTG
1	1	1

Structure of data field:

-----	MPAK	-----
-----	16-1120	-----

UTG is a 1-digit ASCII-coded hex-number which states to which output MPAK is to be sent.

When receiving the S-command, MCU sends MPAK to the output stated by UTG.

The parameter UTG is to be used as follows:

UTG = 0	direct to default output
1	printer
2	audio
3	emergency
4	op. terminal:1 (MASC protocol)
5	op. terminal:2
6	op. terminal:3
7	op. terminal:4
8	op. terminal:5
9	op. terminal:6
A	
B	
C	
D	
E	
F	printer, without printing the MPAK-head

Note 1: When the parameter UTG = F, the datafield consists of printable information except the MPAK-head. The printer should ignore the MPAK-head, this means that the information starts in octet 12.

Description of the different MPAKs can be found in "Network layer for terminals", see reference RI-09.

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2.8 T-command (request/transfer of emergency text).

Structure of text field, request:

T

1

Structure of data field for transfer of emergency text:

Emergency text

0 - 256

The T-command is used by the terminal to set up in MCU the dynamic text part of the emergency signal and as a request to MCU to return the stored emergency text. MCU uses the command as a reply to the request.

The emergency text field is the emergency text which is to be transferred. The emergency text can have up to 256 characters according to MOBITEX textcode. The first two octets of the text part are reserved to indicate the source of the emergency.

Source of emergency: Emergency 1 = 01
 Emergency 2 = 02
 Emergency 3 = 03
 Emergency 4 = 04
 Handset = 05
 OP-terminal 1 = 06

When receiving a T-command with text part, MCU stores emergency text as the dynamic text part of a possible, future SOS packet. When receiving the T-command request, the stored emergency text is sent to the terminal by the T-command with text part.

Description of the emergency packets and procedures (SOS, SOSINFO etc) can be found in "Network layer for terminals", see reference R1-09.

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Cantel Mobitex		St. Nr. 2/1056 - A 296 5175/2 Ue
		Document Date Rev. File No. 1990-02-26 A MTS19A.2
2.9 <u>U-command (send emergency signal SOS)</u>		
U		
1		
<p>The U-command is used by the terminal to initiate the transmission of an emergency signal (SOS packet).</p> <p>When receiving the U-command, MCU creates a SOS packet and sends it to the network. The text part of SOS is made up by the stored emergency text (received earlier by the T-command) where the identity of the emergency source is inserted as the first two octets.</p> <p>Description of the emergency packets and procedures (SOS, SOSINFO etc) can be found in "Network layer for terminals", see reference R1-09.</p> <p>When MCU is in manual mode, it is recommended that the MCU return to MOBITEX operating Mode and sends the packet MPAK:SOS.</p>		
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Date Date Time PL/PL
1990-02-26 A MTS19A.2

2.10 F P-command (MAN request)

The FP-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.11 F Q-command (device handling the MASC protocol)

The FQ-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.12 F F-command (MCU in contact with mobitex)

The FF-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.13 F G-command (MCU not in contact with mobitex)

The FG-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.14 F H-command (MPAK sent over radio path)

The FH-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.15 F K-command (error message from MCU)

The FK-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.16 F O-command (prepare to close down)

The FO-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

2.17 F #-command (short number list)

The F#-command is described in chapter TERMINAL SYSTEM FUNCTIONS F-command.

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No	2/1056 - A 296 5175/2 Ue
Date	1990-02-26 A MTS19A.2

3 TYPE TEST FUNCTIONS (always to be implemented in MCU)

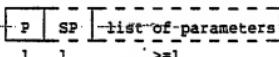
These functions should only be used during type testing and must be made inoperative for normal use.

3.1 P-command (request/list of parameters)

Structure of text field in request for internal parameters from terminal to MCU:



Structure of text field in reply from MCU to terminal (list of parameters):



The data field is empty.

The P-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). The parameters to be sent in the following order:

Parameter	No of bytes
Slot_length	1
TimeOut_short	1
Timeout_long	1
Free_slots	1
Rand_slots	1
Current_base (internal parameters in MCU)	2
Chosen_Slot (internal parameters in MCU)	1
Max_access	1
Max_rep	1
Priority (internal parameter in MCU)	1
Sequential number up (term.MAN)	1
Sequential numbers down (term.MAN+15 groups)	16
Upfreq (current)	2
Dofreq (current)	2
Flexlist (MAN 1 - 7)	21
Grouplist (MAN 1-15)	45

Buttons

Request

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

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3.2 PA-command (request/list of radio-parameters)

Structure of text field in request for internal parameters from terminal to MCU:

PA01

4

Structure of text field in reply from MCU to terminal (list of parameters):

PA01 SP [list of parameters]

4 1 >=23

The data field is empty.

The PA-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Timeout	1
Slot_length	1
Free_slots	1
Rand_slots	1
Max_Rep	1
Max_access	1
Max_speech	1
Txpow	1
Slev1	1
Slev2	1
Scan_time	1
Bad_base	1
Good_base	1
Choose_base	1
Better_base	1
Qpos	1
Current_base (internal parameter in MCU)	2
Chosen_slot (internal parameter in MCU)	1
Priority (internal parameter in MCU,current value)	1
Upfreq (current value)	2
Dofreq (current value)	2
Access_channel_upfreq (current value)	2
Access_channel_dofreq (current value)	2
Network_id (mobile tx)	2
Network_id (mobile rx)	2
Area_id	1

Request

Response

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Pn Pn
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Example of PA01-command:

<u>MCU</u>	<u>TERMINAL</u> <----- PA01 ----->
PA01 01,02,03,04,05,06,07,08,09,10,11,12,13,14,15,16,0017, 18,19,0020,0021,0022,0023,0024,0025,26 ----->	

OR

PA01 01,02,03,04,.....,26

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference RI-16.

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Rapport

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3.3 PA-command (request/list of identity-parameters)

Structure of text field in request for identity parameters from terminal to MCU:

PA02

4

Structure of text field in reply from MCU to terminal (list of parameters):

PA02	SP	[list of parameters]
4	1	>=40

The data field is empty.

The P-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Terminal MAN	3
ESN	4
Flexlist (MAN 0 - 7)	21
Grouplist (MAN 1-15)	45
Sequential number up (term.MAN)	1
Sequential numbers down (term.MAN+15 groups)	16

Example of PA02-command:

MCU	TERMINAL
----->	PA02
PA01	000001,00000002,000003,000004,000005,....,000010,....
.....	26,27,.....,42
	----->

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference RL-16.

Bilders

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3.4 PA-command (request/list of channel-parameters)

Structure of text field in request for parameters from terminal to MCU:

PA03

4

Structure of text field in reply from MCU to terminal (list of parameters):

PA03 SP [list of parameters]

4 1 >=4

The data field is empty.

The P-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Channel list (current)	1
Number of channels in channel_list (total)	2
Number of channels in this command	1
Channel #1 - upfreq	2
Channel #1 - dofreq	2
Channel #2 - upfreq	2
Channel #2 - dofreq	2
...	
Channel-list = 01(hex) DEFAULT_LIST	
02(hex) CURRENT_LIST	
03(hex) TEMP_DEFAULT_LIST	

All parameters in this command is a number of ASCII coded hex number.

Example: Answer with a default list of 100 channels.

PA03 01,0064,3C,0123,0123,.....
 PA03 01,0064,28,0123,0123,.....

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference RI-16.

Bildkort

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3.5 PA-command (request/list of roaming-parameters)

Structure of text field in request for parameters from terminal to MCU:

PA05

4

Structure of text field in reply from MCU to terminal (list of parameters):

PA05	SP	[-----] list of parameters
4	1	>=4

The data field is empty.

The PA-command is used by the terminal to request radio protocol parameters and by MCU to send these parameters as a reply to the request.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Parameter	No of bytes
Number of bases in table	1
Current_base_id	2
roaming_value	1
Base_id	2
roaming_value	1
.	
.	

Example: Mobile terminal with current_base(23) chosen.

PA05 03,0023,09,0025,02,0019,04

Mobile terminal with no chosen current_base.

PA05 03,,,0023,02,0019,01

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference RI-16.

BSC Sheet

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3.6 PA-command (request/list of test-parameters)

Structure of text field in request for parameters from terminal to MCU:

PA06	SP	function	,	[-----]
4	1	2		>= 0

Structure of text field in reply from MCU to terminal (list of parameters):

PA06	SP	function	,	[-----]
4	1	2	1	>=1

The data field is empty.

The P-command is used by the terminal to request for radio protocol parameters and by MCU to send these parameters as a reply to the request.

The function is a ASCII coded decimal number between 00 - 99, describing separate request or answer. Those functions are described below.

The list of parameters consists of a number of ASCII coded hex numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters to be sent in the following order:

Function:

No:	description:	parameter:
01	current_base(Req/ans)	In the answer, the current_base is ASCII coded hex number. Current_base in ASCII coded hex number.
02	set current_base	-
03	disable base_search_mode	-
04	enable base_search_mode	-
05	clear dynamic memory	-
06	enable copy REPMAP when receiving or sending the frame <REB>	An ASCII coded hex number for each bit set to "1" indicating repetition in the frame <REB>. A comma is placed between each number.
07	disable copy REPMAP	-
08	enable loudspeaker	-
09	disable loudspeaker	-

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- No: description: parameter:
 10 copy NUMRET The parameter 'NUMRET' in ASCII coded hex number, stating the number of retransmissions.
 11 enable transmitting the scrambling signal over the radio(see ref R1-17) -
 12 disable transmitting the scrambling signal over the radio(see ref R1-17) -
 13 copy speech parameters. Subscriber, con-id, upfreq, dofreq. Parameters in ASCII coded hex number separated by a comma.

Example:	MCU	Terminal
	PA6-01,1234	<----- PA6 01 ----->
	PA6 06,6,23,35	<----- PA6 02,1234 -----> <----- PA6 06 ----->
	PA6 10,12	<----- PA6 07 -----> <----- PA6 08 -----> <----- PA6 09 -----> <----- PA6 10 -----> <----- PA6 12 -----> <----- PA6 11 -----> <----- PA6 13 ----->
	PA6 13,123456,12,1111,2222	

The meaning and structure of the different parameters can be found in "Data link layer for terminals", see reference R1-16.

Bridget

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3.7 K-command (receive/transmit frequency number)

Structure of text field to frequency number reception:

KM	SP	parameter
2	1	3

Structure of text field to frequency number transmission:

KS	SP	parameter
2	1	3

The data field is empty in both commands.

The parameter field states the frequency number. The number is given as the ASCII codes of the hexadecimal digits of the frequency number in hexadecimal notation.

The K-command is used to set up the frequency pair to be used for reception and transmission. The frequency number range is hexadecimal 001 - 617 (decimal 0001 - 1559).

If the frequency number included in the frame is not implemented in the equipment, MCU will respond with an E-frame (error function).

For correspondence between frequency number and frequency, see reference RI-06 .

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3.8 KA-command (receive/transmit frequency number)

Structure of text field to frequency band:

KAB	SP	FBI
3	1	1

Structure of text field to frequency number, reception:

KAM	SP	parameter
3	1	4

Structure of text field to frequency number transmission:

KAS	SP	parameter
3	1	4

The data field is empty in all commands.

The parameter **FBI** states the frequency band and bitrate. The parameter is given as the ASCII coded hex number of the parameter **FBI** in upfreq and dofreq.

The **parameter** field states the frequency number. The number is given as the ASCII codes of the hexadecimal digits of the frequency number in hexadecimal notation.

The KA-command is used to set up the frequency pair to be used for reception and transmission. The frequency number range is hexadecimal 0001 - 1FFF (decimal 0001 - 8191).

If the frequency number included in the frame is not implemented in the equipment, MCU will respond with an E-frame (error function).

For correspondence between frequency number and frequency, and frequency band(FBI) and bitrate , see reference R1-06.

Bildkort

Reprint

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4 TERMINAL SYSTEM FUNCTIONS (implemented according to application)

4.0 F-command (system control)

The F-command is used from op. terminal to execute the specified function in MCU.
The F-command is used by MCU to send information to the terminal.

Structure of the text field:

F	SP	list of parameters
1	1	>=1

The data field is used only in the FT- and F#-frame with list of channel numbers and short numbers.

The list of parameters is a list of one-character function codes and parameters in ASCII code according to the following table:

- | | | |
|-----|-----|--|
| 4.1 | F B | Change to MOBITEX operation mode
MCU sends an ACTIVE packet to the network |
| 4.2 | F C | Set up a MOBITEX line connection
parameters MAN1,MAN2
MAN is a 6-digit ASCII-coded hex-number.
MAN1=sender, MAN2=addressee.
MCU creates and sends a CONREQ packet to the network. |
| 4.3 | F D | Set up a TELEPHONE line connection
Parameters MAN,TEL
MAN is a 6-digit ASCII-coded hex-number (sender).
TEL is the desired number in the telephone network.
The number is given in MOBITEX textcode, right justified in a 20 character field with leading spaces according to the corresponding field of EXTCONREQ.
MCU creates and sends an EXTCONREQ packet to the network. |
| 4.4 | F E | Disconnect line connection
MCU creates and sends a DISCON packet to the network. |
| 4.5 | F F | Contact with the MOBITEX network
MCU is in contact with the MOBITEX network. |
| 4.6 | F G | No contact with MOBITEX network
MCU has no contact with the MOBITEX network and is trying to establish contact again (roaming procedure started). |

Subject

Report

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<hr/>		
4.7	F H	MPAK sent by the radio to the network Parameter SEQID MCU inform that MPAK has been sent to the network. The parameter SEQID is added if SEQID was included in the M-command. SEQID is a 1-digit ASCII coded decimal number between 0 - 9.
4.8	F I	Cancel previous transmission of MPAK Previously activated transmission of MPAK is cancelled. The MPAK to be returned to the terminal by an N-frame.
4.9	F J	Print out current MANs in terminal Print current MANs in terminal on printer (terminal subscription MAN, group MANs (group_list) and personal subscription MANs (flex_list) in that order.
4.10	F K	Error message about a fault situation Parameter XX Error message where XX is the error number in ASCII coded hex digits 00-FF (0-255). Information from MCU about a fault situation. Description of the meaning fault situation see chapter "Fault situation in mobitex mobile stations".
4.11	F L	Activate external call indication Activate external indication (e.g. horn) for 2 seconds.
4.12	F M	Transmitter on/off Parameter X X = character 0 ---> transmitter off X = character 1 ---> transmitter on
4.13	F N	Change to MANUAL RADIO mode MCU sends an INACTIVE packet to the network.
4.14	F O	Prepare for closing down MCU From terminal: Command to prepare closing down (switching off) the MCU. MCU clears buffers for stored MPAKs. MPAKs to be transmitted to the network are transmitted. All other MPAKs are sent to the terminal. If no contact with the network, MPAK's to the network are returned by the N-command. Then MCU sends an INACTIVE packet to the network. Finally MCU confirms that it is empty by sending a FO-frame to the terminal. From MCU: MCU is empty and ready to be switched off.
<hr/>		
Note: If more than one device connected, the FO-command from the MCU should be sent to all devices.		
<hr/>		
Bucket:		
Report:		

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4.15 F P Terminal MAN request/answer
Request from terminal for terminal subscription MAN.

F PXXXXXX Terminal subscription MAN from MCU to
terminal as response to the request.
XXXXXX is the MAN as a 6 digit ASCII coded
hex number.

4.16 F Q MASC device identity
Parameter XXX
Type of device handling the MASC protocol.
F_Q(MASC_DEVICE) is information to other units
connected to this MASC interface.
XXX = MCU
XXX = MOX

4.17 F R Change network identification
Parameters XXXX,YYYY
Send this new network identification to data link
layer(see reference RI-16).
XXXX = is new-network_ID for mobile tx in ASCII
coded hex number.
YYYY = is new network_ID for mobile rx in ASCII
coded hex number.

4.18 F S Change AREA-LIST
Parameters BITMAP,COM
Send this new area list to data link layer(see
reference RI-09 and RI-16).
BITMAP = see AREALIST reference RI-09.
COM = see Command reference RI-09.
Parameters BITMAP and COM is in ASCII coded hex
digits.

4.19 F T Change TEMP DEFAULT LIST
Parameters TNUM,NUM,M
Send this new channel list to data link layer(see
reference RI-09 and RI-16).
TNUM = Total number of channels. If TNUM is zero,
delete TEMP DEFAULT_LIST and return to
DEFAULT LIST.
NUM = Number Of channels in this command
M = 0 No more channels
M = 1 More channels in next command.
Parameters TNUM, NUM and M is in ASCII coded hex
digits.
The list itself is sent in the data field of the
frame. The list is described in reference RI-16.

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- 4.20 F V Speech queue information
 Parameter XX
 Information about queue-position when waiting for speech to be connected.
 XX is the speech-queue number in ASCII coded hex digits in the range 00-FF.
- 4.21 F # Short number list
 Request from terminal for short number list.
- F #XX List of short numbers from MCU or terminal.
 The list contains short numbers which are common to MCU and all connected terminals (general short numbers). It is sent by the terminal to set up this list and by MCU as a reply to the F# request frame from the terminal.
 XX is the number of short numbers in the list in ASCII coded hex digits in the range 00-32 (0-50 decimal).
 The list itself is sent in the data field of the frame. In the list, the actual numbers corresponding to each short number from 1 and up are given as ASCII coded digits with a maximum of 20 digits each. The numbers are separated by the character , (comma).

NOTE: Only the 'one-character function' can be included in an F-command, e.g. F P123456.

Description of the different packets and procedures mentioned here can be found in reference R1-09 and R1-16.

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5 AUDIO FUNCTIONS (implemented according to application)**5.0 A-command (controlling audio functions)**

Structure of text field:

A	SP	list of parameters
1	1	>=1

The data field is empty.

The A-command is used to control the audio equipment.

The list of parameters is a list of one-character function codes and parameters in ASCII code according to the following table:

5.1 A B Increase audio volume level

5.2 A C Decrease audio volume level

5.3 . A D Loudspeaker on/off

Parameter X

X = character 0 --> off

X = character 1 --> on

5.4 A E External call indication on/off

Parameter X

X = character 0 --> off

X = character 1 --> on

5.5 A H Microphone (hook) on/off

Parameter X

X = character 0 --> off

X = character 1 --> on

5.6 A I Transmit/receive switch

Parameter X

X = character 0 --> transmit

X = character 1 --> receive

5.7 A J Hands free.

Parameter X

X = character 0 --> off

X = character 1 --> on

5.8 A V Audio level order.

Parameter X

X=data, ASCII coded hex digit 0-F.

Buttons

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NOTE: Only the 'one-character function' can be included in an A-command, e.g. A EO.

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6 MANUAL RADIO MODE FUNCTIONS (implemented according to application)								
6.0 <u>H-command (controlling manual radio mode)</u>								
Structure of text field:								
<table border="1"> <tr> <td>R</td> <td>SP</td> <td>list of parameters</td> </tr> <tr> <td>1</td> <td>1</td> <td>>=1</td> </tr> </table>			R	SP	list of parameters	1	1	>=1
R	SP	list of parameters						
1	1	>=1						
The data field is empty.								
The H-command is used to control the radio equipment when in manual radio mode.								
The list of parameters field is a list of one-character function codes and parameters in ASCII code according to the following table:								
6.1 H A Change to MOBITEX mode. MCU sends an ACTIVE packet to the network.								
6.2 H B Increase audio volume level.								
6.3 H C Decrease audio volume level.								
6.4 H D Loudspeaker on/off. Parameter X X = character 0 --> off. X = character 1 --> on.								
6.5 H E External call indication on/off. Parameter X X = character 0 --> off. X = character 1 --> on.								
6.6 H F Call indication Parameter X X = character 0 --> no call received X = character 1 --> call received								
6.7 H G Squelch open/closed (toggle).								
6.8 H H Microphone (hook) on/off. Parameter X X = character 0 --> off. X = character 1 --> on.								
6.9 H I Transmit/receive switch Parameter X X = character 0 --> transmit X = character 1 --> receive								

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6.10 H J	Hands free. Parameter X X = character 0 --> transmit X = character 1 --> receive	
6.11 H K	Change to channel number. Parameter XX Change to channel number XX where XX is the desired channel number in ASCII coded hex digits in the range 01-63 (1-99 decimal).	
6.12 H L	Channel number indication. Parameter XX XX is the channel number in ASCII coded hex digits in the range 01-63 (1-99 decimal). Will be sent when start up or a changed channel occur.	
6.13 H M	Send selective call number. Parameter XXXXXX Send selective call number XXXXXX on current channel. X is an ASCII coded digit 0-9. If the number of digits is less than 7, the number will be left justified and the XXXXXX-field will be filled with trailing spaces (hex code 20).	
6.14 H N	Scan the specified channels. Parameter XX..XX XX..XX is a list of maximum 8 channel numbers in a field of 16 octets. Each XX represents a channel number in ASCII coded hex digits in the range 01-63 (1-99 decimal). If the number of channels is less than 8, the field will be filled with trailing spaces (hex code 20). The specified channels are scanned for carrier or selective call.	
6.15 H O	Carrier indication. Parameter X The frame must be transmitted only when there is a change between sensing carrier and sensing no carrier. The carrier sense itself should be updated at least once per second. X = character 0 --> no carrier X = character 1 --> carrier	
6.16 H P	Copy of own selective number. Parameter XXXXXX Copy of the own selective call number. X is an ASCII coded digit 0-9. If the number of digits is less than 7, the number will be left justified and the XXXXXX-field will be filled with trailing spaces (hex code 20).	
6.17 H Q	Transmit/receive indicator Parameter X	

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X = S ---> transmitting (sending)
X = M ---> receiving (monitoring)

Note: Only the 'one-character function' can be included in an H-command, e.g. H P1234567.

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Cantel Mobitex

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7 Signalling between MCU and terminal equipment connected to the MASC interface.

7.0 General

These chapters have been included because the network layer may be differently implemented in different terminal equipment. For any terminal equipment, connected to MCU via the MASC interface, the MCU can be considered as a DCE for connection to the MOBITEX network. A terminal can have a complete MOBITEX network layer or a simplified network layer, using different commands of the MASC protocol.

A terminal connected to the MCU must have the same terminal MAN number as the MCU.

The terminal MAN must be associated to at least one output connection, either a MASC interface or another connection (e.g. a handset or a printer).

All messages to groups, belonging to terminal MAN, should be directed to the same output connection(s) as terminal MAN.

The MCU has the responsibility towards the MOBITEX network according to the network layer.

In order to get the MOBITEX network layer in MCU and the terminal to interact correctly, the following chapters have to be considered.

7.1 MPAK received from the network

ROAMORD, FLEXREQ, INFOREQ and ESNREQ will be completely handled within the MCU without notifying any connected terminal.

DIE and LIVE will be completely handled within the MCU but notified by FK-command(if handled) to connected terminals.

All other correctly received MPAKs will, after normal handling in the MCU, be sent to the output connection where the addressed MAN is located.

A fixed terminal can't receive a CONORD, therefore CONORD is to be converted to a CONREQ by the MCU.

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7.2 MPAK received from a terminal

Normally, if the MPAK passes the checks in the MCU, the MPAK will be sent to the network. The MCU should react and enter states as if the MPAK was generated in the MCU (e.g. on CONREQ the MCU should enter a state for call in progress, and should also act according to the radio protocol for sending such MPAK).

If the checks fail, the MPAK should be returned to the terminal by an R-frame.

For the following MPAK's, however, the MCU should have a special treatment.

- | | |
|------------------------------------|---|
| CONREA | to be treated as a hook off-signal |
| DISCON | .. to be treated as a hook on-signal |
| FLEXREQ | if the personal subscription already exist in flexlist the terminal will be informed by FK-frame. |
| FLEXLIST | to be returned to the terminal by an R-frame. |
| BORN,
ROAM,
INFO,
ESNINFO | to be returned to the terminal by an R-frame. |
| LINEON,
LINEOFF | to be returned to the terminal by an R-frame. |

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7.3 Connection between the MCU and the terminal

The terminal is supposed to have a list of groupMAN's and a list of personal subscriptions (flexlist). In order to get the lists in the MCU equivalent to the list in the terminal, the following should be considered.

Each time the link layer connection is established (by exchange of B-frames), the terminal will send:

- MANREQ (command F P) to request MCU for the terminal MAN

To answer this, the MCU sends the terminal MAN in the command MAN (command F P). This answer should be sent immediately or, if another frame is currently being transmitted by the MCU, immediately after the transmission is completed. After that, the MCU will send the MASC_DEVICE command (F Q).

The MCU should send:

- GROUPLIST to set the list of groupMAN in the terminal
- FLEXLIST to set the flexlist in the terminal.

The terminal will then handle the flexlist according to the specification, see R1-09.

Build sheet

Reprocs

A 292 5155/2

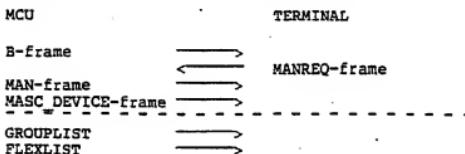
Cantel Mobitex-

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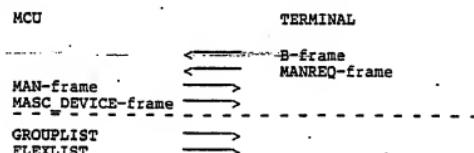
P.L.-File

MTS19A.2

Example of start sequence when MCU starts.



Example of start sequence when TERMINAL starts:



Note: Packets above the dotted line in each sequence belong to the link layer, and packets below the dotted line belong to the network layer.

7.4 Signalling between MCU and more than one terminal

The MCU may have more than one MASC interface.

All MASC interfaces should have the same start sequence as described in chapter "Connection between the MCU and the terminal".

The MCU handles all MPAKs and messages to different output connections where the MAN is located.

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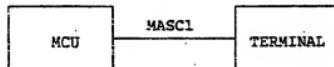
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7.5 Description of a system with MASC interface.

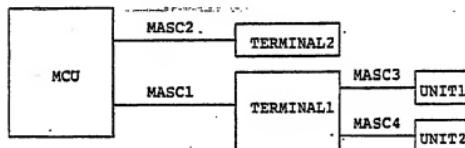
7.5.1 MCU connected to one terminal.



MCU handles the terminal MAN, group MAN and personal MAN with GROUPLIST and FLEXLIST in the start sequence.

After the start sequence, all MPAKs are routed to the terminal.

7.5.2 MCU connected to two terminals.



MCU handles the terminal MAN, group MAN and personal MAN with GROUPLIST and FLEXLIST in the start sequence.

All terminals that have other terminal equipment connected, will have the same start sequence as described in chapter "Connection between the MCU and the terminal". These terminals should be considered as an MCU by the connected units.

After the start up sequence all MPAKs are routed to the current terminal.

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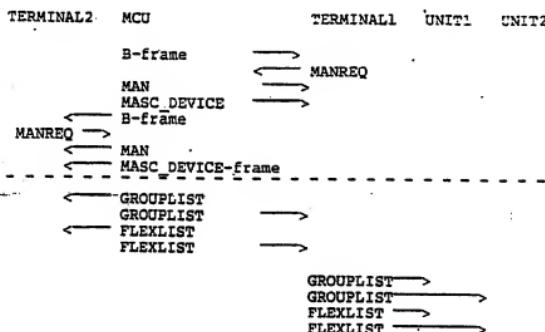
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Date Recd	1990-02-26 Rev A

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Examples of start sequences.

EXAMPLE 1.

Lists when MAN are correct and MCU starts.



Note: Packets above the dotted line in the sequence belong to the link layer, and packets below the dotted line belong to the network layer.

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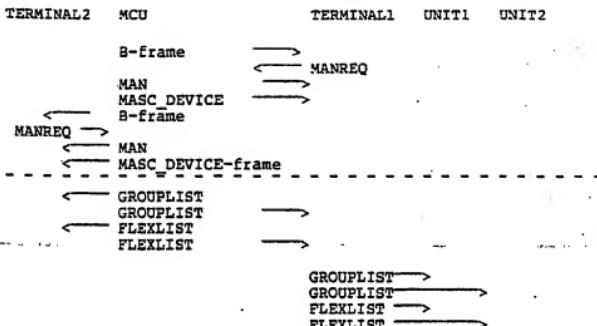
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EXAMPLE 2

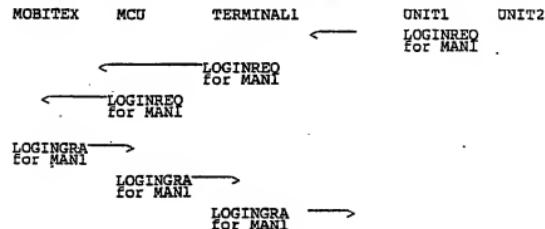
MAN1 is only in UNIT1 and TERMINAL1. MAN2 is only in MCU. MAN1 and MAN2 are personal subscriptions not included in MCU's flexlist.



Note 1: The terminal/unit1/unit2 will replace former lists with these new lists. When replacing the flexlist the terminal/unit1/unit2 will decide if MAN1 and MAN2 are connected or disconnected. If connected, a loginreq is sent from MAN1 in unit1 and a loginreg sent from MAN2 in unit2. If not connected an presentation of the location is sent to the user.

Note 2: The application in UNIT1 has to send LOGINREQ for MAN1 if it wishes to keep MAN1.

Note 3: Packets above the dotted line in the sequence belong to the link layer, and packets below the dotted line belong to the network layer.



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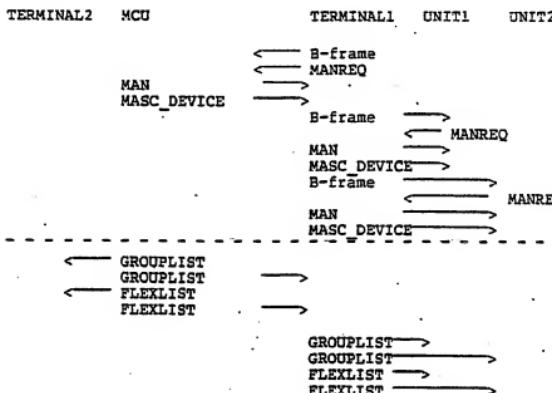
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EXAMPLE 3.

TERMINAL1 is starting the connection.



Note: Packets above the dotted line in the sequence belong to the link layer, and packets below the dotted line belong to the network layer.

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7.6 Fault situation in mobitex mobile stations.

This is a recommendation of error message from the MCU to the connected unit using a MASC interface. This error message is a response for a fault situation and sent as an error number in the FK-command(see chapter "Information frame commands and functions").

Error numbers 0 - 4F is reserved for specific meaning. Error numbers 50 - FF is free to use.

New meaning of error numbers is described in R1-06.

Error no: meaning:

0	reserved
1	DIE mode. An MPAK:DIE is received. No user traffic can be sent from the MCU.
2	LIVE mode. An MPAK:LIVE is received.. User traffic can be sent from the MCU.
3	SPEECH mode. The MCU is in speech mode and can not send any traffic except MPAK:CSUBCOM.
4	MANUAL mode. The MCU is in the manual mode and not in contact with mobitex network.
5	reserved
6	reserved
7	reserved
8	reserved
9	reserved
A	Receiver buffer full, waiting for free buffer.
B	Buffer/memory free.
C	No memory, waiting for more memory.
D	reserved
E	reserved
F	reserved

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Error no: meaning:

- 10 Returned MPAK during die mode.
- 11 Returned MPAK during speech mode.
- 12 Returned MPAK during manual mode.
- 13 Returned MPAK during buffer full.
- 14 reserved
- 15 reserved
- 16 Loginrequest MAN already exist in the flexlist.
- 17 Loginrequest MAN is not possible, flexlist is full.
- 18 MPAK sender MAN is not in TMAN or flexlist.
- 19 reserved
- 1A reserved
- 1B reserved
- 1C reserved
- 1D reserved
- 1E reserved
- 1F reserved
- 20 - 4F reserved

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8 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

RI-06, 27, 28, 45
 RI-09, 9, 11, 12, 14, 15, 16, 17, 31, 32, 39
 RI-16, 19, 21, 22, 23, 24, 26, 31, 32
 RI-17, 26

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
RI-01	Arrangement of the documents
RI-02	-MOBITEX System description
RI-03	General description of terminals
RI-04	Terminology
RI-05	References
RI-06	Network operator information
RI-08	Application layer
RI-09	Network layer
RI-11	Interface requirements, fixed terminals
RI-12	Other requirements, fixed terminals
RI-16	Link layer, mobile terminals
RI-17	Physical layer, mobile terminals
RI-18	Radio equipment, mobile terminals
RI-19	Other interfaces, mobile terminals
RI-20	Other requirements, mobile terminals

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		REQUIREMENT SPECIFICATION			Rev. 1(38)
Customer - Project ET/SYS PES	Supplier - Company ET/SYS PES	No. 1a			
Document Name: MTS19B.1 ET/SYSC STT SIT		1/1056 - A 296 5175 Ue			
		Date rev.	Page	Page	
		1990-02-23	B	M	MTS19B.1
Description		The MOBITEX Terminal Specification Other interfaces, mobile terminal APPENDIX B, Application example			

APPLICATION EXAMPLE

OF HOW TO MAKE AN ALTERNATE CONNECTION VIA MCU
FOR FIXED TERMINALS WITH MASC INTERFACE.

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1 INTRODUCTION

This document describes an example (i.e. not a specification) of an MCU application. Its purpose is to make it easier for the manufacturers. For the understanding of this document, the reader has to be well informed about the Network layer for terminals (reference RI-09) and Link layer for mobile terminals (reference RI-16).

A fixed terminal may be directly connected to the MOBITEX network via a masc interface (MASC) see document "Other interfaces" and appendix A "Commands". The application in this document describes how such a terminal may be connected via an MCU, that handles the masc interface. As to the requirements of such a terminal, please refer to chapter 7 in this document.

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2 MCN WITH APPLICATION

Figure 1 shows an MCU with its processes. Each process communicates with the other processes as is indicated by the arrows in the figure.

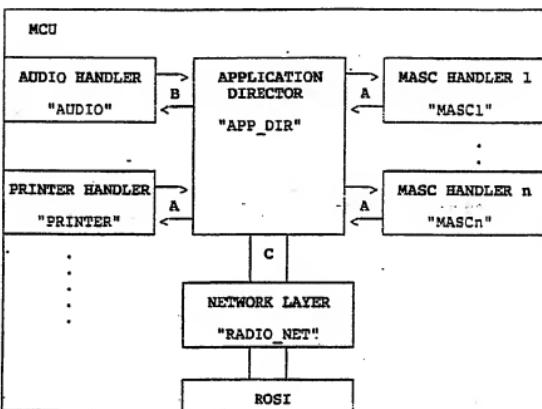


FIGURE 1

In the centre of figure 1 is a process called APP_DIR, application director. This document will describe that process.

Each MASC handler (MASC1 to MASCn) handles a masc interface.

The audio handler (AUDIO) handles an audio interface.

The printer handler (PRINTER) handles a printer, connected to the MCU.

Furthermore one may have "emergency handler", "terminal with small display handler" etc.

The network layer (RADIO NET) is a normal MOBITEX network layer for mobile terminal, plus the additions made in chapter 7 (Requirements on network layer in MCU in this application).

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The letters A, B and C represent different signalling sequences. Observe that the MASC handler and the printer handler acts similarly towards the application director. All handlers act in the same way as an MASC handler towards the application director.

Following terms are used in this document:

- line handler common name for all handlers. E.g. MASC1, MASC7, AUDIO ...
- MCU_MAN the mobile terminal's MOBITEX subscription number.

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3 DESCRIPTION OF SIGNALS

All signals that are handled by APP_DIR have the following structure:

origin Original sender. Can be: line handler,
 RADIO_NET or
 APP_DIR.

from Sender. Can be : line handler,
 RADIO_NET or
 APP_DIR.

signal_status Signal status can be signal_status_ok or
 signal_status_not_sent.
Signal status is always set to
signal_status_ok when the signal is
created.
If the RADIO_NET or any of the line
handlers fails to transmit a signal,
signal status will be set to
signal_status_not_sent. Then the signal
is returned to APP_DIR.

signal_type Can be: S_hook_on,
 S_hook_off,
 S_MPak,
 S_MPak_sent_on_radio,
 S_returned_Incorrect_MPak,
 S_not_sent_MPak
 S_line_up,
 S_line_down.

(MPAK) If signal_type is S_MPak, S_not_sent_MPak
or S_returned_incorrect_MPak, it contains
an MPAK in this field.

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Description of the signal types:

S_line_up

S_line_up is sent by all line handlers to APP_DIR after a correct start or restart.

If the line handler is an MASC handler, the starting up sequence will send a PRIM MASC frame and an acknowledgement of this will be received from the connected unit before S_line_up may be sent.

If the line handler is a PRINTER, it is recommended that S_line_up is not sent until the modem signals say there is a printer connected.

S_line_down

S_line_down is sent by all line handlers to APP_DIR when the unit is disconnected.

If the line handler fails to transmit a signal to the connected unit, S_line_down will be sent to APP_DIR together with the signal being returned.

S_MPak

S_MPak is the normal signal being sent between line handler and APP_DIR and between RADIO_NET and APP_DIR. In the normal case, signal status is signal_status.OK. But in the case when line handler or RADIO_NET fails to transmit the signal, signal status will be set to signal_status.not_sent and the signal will be returned to APP_DIR. For further information see examples below (chapter 4).

When an S_MPak is received by the MASC-handler, the MASC-handler must send an M-frame to the connected unit according to the masc protocol.

When an M-frame is transmitted from the connected unit to the MASC-handler, the MASC-handler must send an S_MPak to APP_DIR.

S_returned_incorrect_MPak

S_returned_incorrect_MPak is sent by APP_DIR to line handler if an incorrect MPak was received.

If an MASC handler receives a S_returned_incorrect_MPak, this MPak will be sent to the connected unit in an R-frame according to the masc protocol.

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S not sent MPAK.

S not sent MPAK is sent by APP_DIR to line handler if, for some reason, it is impossible to transmitt a mpak on radio.

If an MASC handler receives a S_not_sent_MPAK, this MPAK will be sent to the connected unit in an 'N-frame according to the masc protocol.

S MPAK sent on radio

S_MPAK_sent_on_radio is sent by RADIO_NET to APP_DIR when an MPAK has been sent via radio. Origin helps APP_DIR to direct this signal to correct line-handler. When The MASC handler receives an S_MPAK_sent_on_radio, it uses the masc F_H-frame to send the signal to connected unit.

S hook off

S_hook_off is sent by AUDIO to APP_DIR at hook off. APP_DIR updates its registers and passes the signal on to RADIO_NET.

An MPAK CONREA, received by APP_DIR from connected unit, will not be sent to RADIO_NET. Instead S_hook_off will be sent from APP_DIR to RADIO_NET.

S hook on

S_hook_on is sent by AUDIO to APP_DIR at hook on. APP_DIR updates its registers and passes the signal on to RADIO_NET.

An MPAK DISCON, received by APP_DIR from connected unit, will not be sent to RADIO_NET. Instead S_hook_on will be sent from APP_DIR to RADIO_NET.

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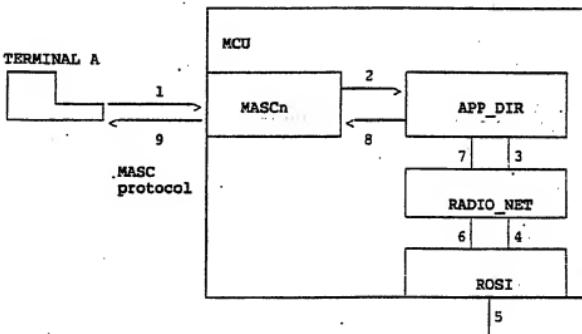
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4 EXAMPLES OF SIGNALLING IN THIS APPLICATION

4.1 EXAMPLE 1: sending TEXT successfully

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. Transmission via radio is successful.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAPK	MASCh	MASCh	signal_status_ok
3	S_MPAPK	MASCh	APP_DIR	signal_status_ok
4 - 6	are not handled in this document.			
7	S_MPAPK sent on radio	MASCh	RADIO_NET	signal_status_ok
8	S_MPAPK sent on radio	MASCh	APP_DIR	signal_status_ok
9	masc frame F_H			

Observe that origin = MASCh through the whole sequence. This gives APP_DIR an opportunity to route signals easier back to the sender.

Sender:

Replies:

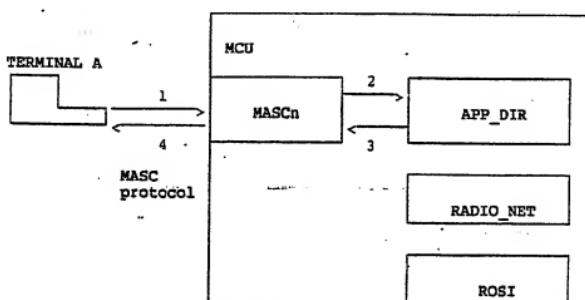
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4.2 EXAMPLE 2: sending TEXT unsuccessfully

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. APP_DIR discovers some kind of error.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	s_MPak	MASCn	MASCn	signal_status_ok
3	s_returned- I_incorrect_MPak	MASCn	APP_DIR	signal_status_ok
4	masc frame R			

Observe that signal 3 has signal status set to signal_status_ok. Only line handlers and RADIO_NET may set signal status to signal_status_not_sent.

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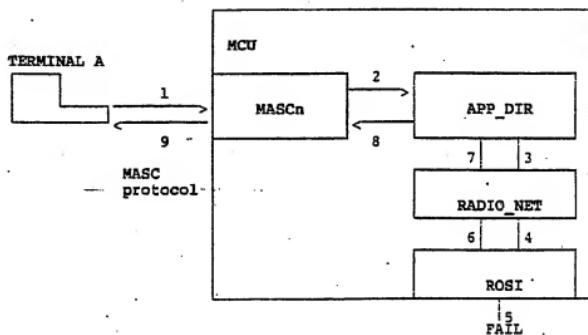
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4.3 EXAMPLE 3: sending TEXT unsuccessfully

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. Transmission via radio fails.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAK	MASCh	MASCh	signal_status_ok
3	S_MPAK	MASCh	APP_DIR	signal_status_ok
4 - 6	are not handled in this document.			
7	S_MPAK	MASCh	RADIO_NET	signal_status-not sent
8	S_not_sent_MPAK	MASCh	APP_DIR	Signal_status_ok
9	masc frame N			

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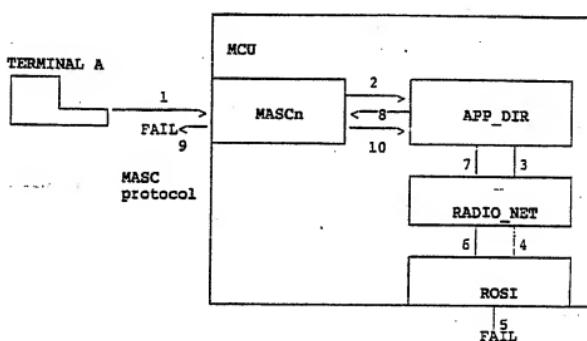
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4.4 EXAMPLE 4: sending TEXT unsuccessfully.

Unit A sends an MPAK TEXT to a subscriber B in the MOBITEX network. Transmission via radio fails. The MCU fails to return the packet to unit A.



signal	signal_type	origin	from	signal_status
1	masc frame M			
2	S_MPAPK	MASCn	MASCn	signal_status_ok
3	S_MPAPK	MASCn	APP_DIR	signal_status_ok
4 - 6	are not handled in this document.			
7	S_MPAPK	MASCn	RADIO_NET	signal_status_not_sent
8	S_not_sent_MPAPK	MASCn	APP_DIR	signal_status_ok
9	masc Frame N			
10	S_not_sent_MPAPK	MASCn	MASCn	signal_status_not_sent

This sequence is the same as the one in example 3, except for signal 10. When receiving signal 10, APP_DIR discovers that origin = from, i.e. the signal is returned even from the MASC handler. The only thing APP_DIR can do is to forget the signal.

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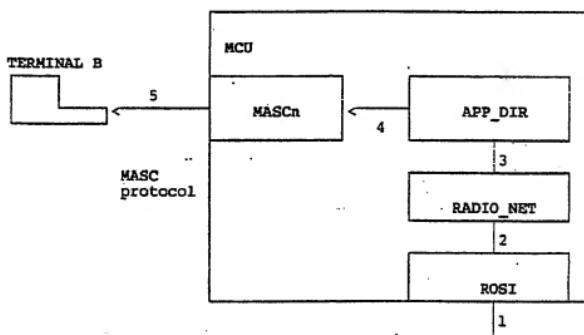
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4.5 EXAMPLE 5: receiving TEXT successfully.
MCU receives an MPAK TEXT, addressed to MCU-MAN.



signal	signal_type	origin	from	signal_status
1	- 2	are not handled in this document.		
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			

The sequence above is valid if there is only one line handler.

If an MPAK is addressed to the MCU.MAN, and there is more than one line handler, APP_DIR will send a copy of signal 4 to each one of them. But if the MPAK is addressed to a transferred MAN, APP_DIR will know on which of the line handlers this MAN can be reached.

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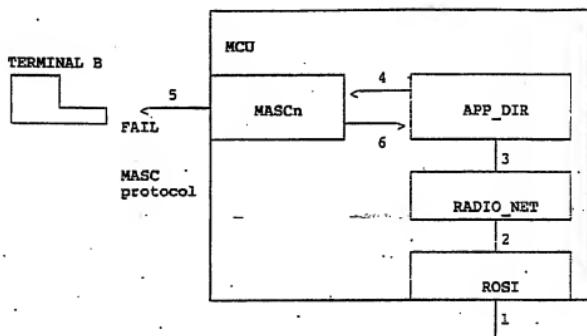
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4.6 EXAMPLE 6: receiving TEXT unsuccessfully

MCU receives an MPAK TEXT to unit B. Transmission to unit B fails. There is only one receiver in this example and MPAK is addressed to MCU_MAN.



signal	signal_type	origin	from	signal_status
1 - 2 are not handled in this document.				
3	S_MPAPK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAPK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			
6	S_MPAPK	RADIO_NET	NASCn	signal_status_not_sent

Observe that an MPAK, addressed to MCU_MAN or any MAN included in the grouplist, must not under any circumstances, be returned to the MOBITEX network. In this application, APP_DIR forgets the MPAK.

Buttons

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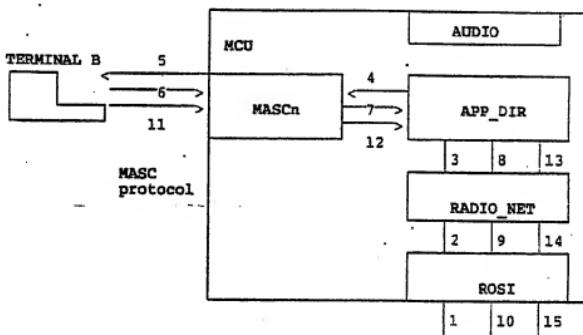
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4.7 EXAMPLE 7: receiving CONREQ

MCU receives an MPAK CONREQ addressed to unit B. Unit B responds with an MPAK CONREA after which the call can begin. Unit B terminates the call by sending an MPAK DISCON.



signal	signal_type	origin	from	signal_status
1 - 2	are not handled in this document.			
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			
6	masc frame M			
7	S_MPAK	MASCn	MASCn	signal_status_ok
8	S_hook_off	MASCn	APP_DIR	signal_status_ok
9 - 10	are not handled in this document.			
11	masc frame M			
12	S_MPAK	MASCn	MASCn	signal_status_ok
13	S_hook_on	MASCn	APP_DIR	signal_status_ok
14 - 15	are not handled in this document			

Note: signal 1 - 5 contains MPAK CONREQ.
 signal 6 - 7, 9-10 contains MPAK CONREA
 signal 11 - 12, 14-15 contains MPAK DISCON

In this application S_hook_on and S_hook_off are always sent, instead of MPAK DISCON and MPAK CONREA, to the RADIO_NET.

Block diagram:

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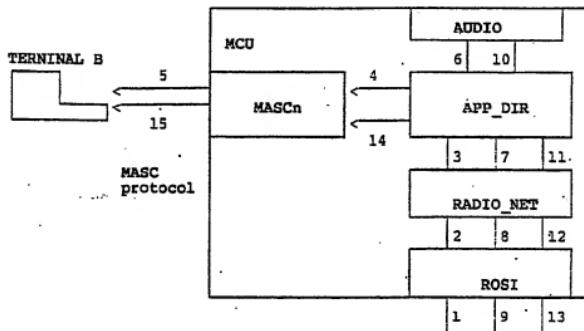
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4.8 EXAMPLE 8: receiving CONREQ

MCU receives an MPAK CONREQ addressed to unit B. The audio interface generates a hook off after which the call can begin. The call is terminated by the audio interface generating an hook on.



signal	signal_type	origin	from	signal_status
1 - 2	are not handled in this document.			
3	S_MPAK	RADIO_NET	RADIO_NET	signal_status_ok
4	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
5	masc frame M			
6	S_hook_off	AUDIO	AUDIO	signal_status_ok
7	S_hook_off	AUDIO	APP_DIR	signal_status_ok
8 - 9	are not handled in this document.			
10	S_hook_on	AUDIO	AUDIO	signal_status_ok
11	S_hook_on	AUDIO	APP_DIR	signal_status_ok
12 - 13	are not handled in this document			
14	S_MPAK	RADIO_NET	APP_DIR	signal_status_ok
15	masc frame M			

Note: signal 1 - 5 contains MPAK CONREQ
 signal 8 - 9 contains MPAK CONREA
 signal 12 - 15 contains MPAK DISCON

Observe that APP_DIR generates MPAK DISCON to unit B .
 This is to avoid blocking situations in unit B.

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5 LISTS OF SIGNALS

Signals that are sent within the MCU, interfaces A, B and C in figure 1, are listed below. The signals are divided into categories of normal and returned signals.

5.1 Interface A

5.1.1 Signals sent from APP_DIR to line handlers

Normal signals

S_MPAK

origin	=	creator of this signal
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_MPAK
MPAK	=	MPAK in question

S_not_sent_MPAK

origin	=	creator of original MPAK
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_not_sent_MPAK
MPAK	=	MPAK in question

S_returned_incorrect_MPAK

origin	=	creator of original MPAK
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_returned_incorrect_MPAK
MPAK	=	MPAK in question

S_MPAK_sent_on_radio

origin	=	creator of original MPAK
from	=	APP_DIR
signal_status	=	signal_status_ok
signal_type	=	S_MPAK_sent_on_radio

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5.1.2 Signals sent from line handlers to APP_DIR

Normal signals

S_line_up
 origin = line handler in question
 from = origin
 signal_status = signal_status_ok
 signal_type = S_line_up

S_line_down
 origin = line handler in question
 from = origin
 signal_status = signal_status_ok
 signal_type = S_line_down

S_MPak
 origin = line handler in question
 from = origin
 signal_status = signal_status_ok
 signal_type = S_MPak
 MPak = MPak in question

Returned signals

S_MPak
 origin = no change in this field
 from = line handler in question
 signal_status = signal_status_not_sent
 signal_type = S_MPak
 MPak = MPak in question

S_MPak_sent_on_radio
 origin = no change in this field
 from = line handler in question
 signal_status = signal_status_not_sent
 signal_type = S_MPak_sent_on_radio

S_returned_incorrect_MPak
 origin = no change in this field
 from = line handler in question
 signal_status = signal_status_not_sent
 signal_type = S_returned_incorrect_MPak
 MPak = MPak in question

S_not_sent_MPak
 origin = no change in this field
 from = line handler in question
 signal_status = signal_status_not_sent
 signal_type = S_not_sent_MPak
 MPak = MPak in question

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5.1.3 Signals from APP_DIR to AUDIO

All signals listed in 5.1.1.

5.1.4 Signals from AUDIO to APP_DIR

All signals listed in 5.1.2, plus the following:

```
S_hook_off
    Origin      =  AUDIO
    from        =  AUDIO
    signal_status =  signal_status_ok
    signal_type   =  S_hook_off

S_hook_on
    Origin      =  AUDIO
    from        =  AUDIO
    signal_status =  signal_status_ok
    signal_type   =  S_hook_on
```

5.1.5 Signals from APP_DIR to RADIO_NET

Normal signals

```
S_MPAC
    origin      =  creator of this signal
    from        =  APP_DIR
    signal_status =  signal_status_ok
    signal_type   =  S_MPAC
    MPAC         =  MPAC in question

S_hook_on
    Origin      =  AUDIO
    from        =  APP_DIR
    signal_status =  signal_status_ok
    signal_type   =  S_hook_on

S_hook_off
    Origin      =  AUDIO
    from        =  APP_DIR
    signal_status =  signal_status_ok
    signal_type   =  S_hook_off
```

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5.1.6 Signals from RADIO_NET to APP_DIR

Normal signals

S_MP4K

```

origin      =  RADIO_NET
from        =  origin
signal_status = signal_status_ok
signal_type   =  S_MP4K
MP4K         =  MP4K in question

```

Returned signals

S_MP4K

```

origin      =  no change in this field
from        =  RADIO_NET
signal_status = signal_status_not_sent
signal_type   =  S_MP4K
MP4K         =  MP4K in question

```

S_hook_on

```

Origin      =  AUDIO
from        =  RADIO_NET
signal_status = signal_status_not_sent
signal_type   =  S_hook_on

```

S_hook_off

```

Origin      =  AUDIO
from        =  RADIO_NET
signal_status = signal_status_not_sent
signal_type   =  S_hook_off

```

Sender:

Replies:

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6 REGISTERS IN APP_DIR

Four registers are kept in APP_DIR:

6.1 Register number one: MCU_REG

The register called MCU_REG has the structure shown in the figure below.

LINE	MASC1	MASC2	MASC3	AUDIO	PRINTER
MAY / MAY NOT INACTIVATE MCU					
LINE_UP / LINE_DOWN					
MSG	TEXT				
TYPE	STATUS				
	DATA				
	HPDATA				
	SPEECH				
	EMERGENCY				
	EXTPAK				

line

Contains the line handlers that exist in this application. This is static information.

msg type

Tells which MPACKs, addressed to MCU MAN or any MAN in the grouplist, will be received by the Line handler. As an example, there is nothing to prevent that MPACK TEXT is received by a number of line handlers. In the speech connection case, in this particular application, only one line handler can be enabled. Msg type contains static information.

may/may not inactivate MCU

Tells whether the line handler in question is allowed to inactivate MCU with an MPACK DTESERV.INACTIVE. Normally, only one (or very few) of the line handlers should be allowed to do this. This is static information.

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line up/down

Contains information about each of the connected line handlers. This information is dynamic.

The figure below shows how the MCU_REG may be used.

LINE	MASC1	MASC2	MASC3	AUDIO	PRINTER
MAY / MAY NOT INACTIVATE MCU	MAY	NOT	NOT	NOT	NOT
LINE UP / LINE DOWN	UP	UP	DOWN	UP	UP
MSG	TEXT	X	X	X	
	STATUS			X	
TYPE	DATA	X			
	HDATA	X			
	SPEECH	X			
	EMERGENCY	X			
	EXTPAK	X			

In this case, only MASC1 is allowed to inactivate the MCU. All line handlers, except for MASC3, are connected and intact. When APP_DIR receives an MPAK TEXT from MOBITEX network, it will be sent to MASC1, MASC2 and PRINTER. Since MASC3 does not have status line up, it does not receive any MPAKs. Received MPAK STATUS is to be sent to AUDIO. Other MPAKs are to be sent to MASC1.

Observe that APP_DIR does not keep information of if MCU is active or inactive. Nor does APP_DIR know if RADIO NET has received an MPAK DIE from the MOBITEX network. It is the responsibility of RADIO NET to keep information about this. If RADIO NET notes which APP_DIR is not allowed to send to the MOBITEX network, the packets are returned to APP_DIR with signal status set to signal_status_not_sent.

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6.2 Register number two: FLEXLIST

The FLEXLIST register has the structure shown in the figure below.

MAN	LINE	STATUS

MAN - The MOBITEX subscription number of the transferred subscriber. Up to seven MAN-numbers are allowed.

LINE - The line handler to which the transferable has transferred..

STATUS - Tells login status.

It can be: UNDER_LOGIN - the login sequence is not yet finished

OK_LOGIN - the login sequence is finished and accepted

6.3 Register number three: GROUPLIST

The GROUPLIST contains a list of group MAN numbers. Up to 15 MAN numbers is allowed.

6.4 Register number four: CONNECTION_REG

CONNECTION_REG keeps information about the status of the speech line. It contains the following information:

CONNECTION_STATUS - can be free, busy or waiting_for_hook_off

CONNECTION_PARTY_HERE - MAN number for connection part in the MCU

CONNECTION_OTHER_PARTY - MAN number for the other connection part

CONNECTION_CONN_ID - connection identity for current speech line connection

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7 REQUIREMENTS ON THE NETWORK LAYER IN MCU

Requirements on the network layer in MCU (RADIO_NET) are listed below:

1. Everything applicable to mobile terminal in document MOBITEX network layer for terminals, 5/1056 - A 296 5171.
 2. All MPAKs that the application wants to send via radio and network layer to
 - be acknowledged to the application if the transmission was successful,
 - be returned to the application if the transmission failed.
 3. The signals hook_on and hook_off will be returned to the application if the transmission via radio fails.
 4. The following MPAKs, received by the MCU via radio, to be sent to the application:
 - all MPAKs of class PSUBCOM
 - all MPAKs of class PSOSCOM.

Note that a transferred subscriber, connected to the MCU via an MASC handler, can be emergency receiver.
 - following MPAKs, belonging to the class CSUBSOM:
 - + CONREQ
 - + ADDCONREQ
 - + SOSCONREQ
 - + EXTCONREQ
 - + CONORD
 - + DISCON
 - following MPAKs, belonging to the class DTESERV:
 - + LOGINREQ * **
 - + LOGINREF **
 - + LOGOUTORD **
 - + LOGINGRA **
 - + FLEXILIST **
 - + TIME
 - + GROUPLIST **
 - + SOSRX * ***
 - + VICESOSRX * ***
- * These MPAKs can only have MPAK states that are not OK.
 ** These MPAKs concern flexilist and grouplist. They are handled by the network layer and sent to the application. The reason for this is that the application has copies of flexilist and grouplist.
 *** Only if a terminal, connected to the MCU, has an emergency receiver transferred to it.

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8 REQUIREMENTS ON A FIXED TERMINAL

The requirements for a fixed terminal which is able to connect to the MOBITEX network as well as the MCU are as follows.

Link layer

Frames in the masc protocol for implemented:

All control frames : ACK, RACK, NACK, SENS, SACK

Following information frames:

B, M, E, R, F_P, F_Q, N

Network layer

The MOBITEX network considers a fixed terminal, connected via an MCU, as a mobile terminal. This has the following consequences as to which MPAKs may be sent and received by the terminal.

class PSUBCOM:

The terminal is allowed to send and receive all MPAKs in this class.

class PSOSCOM:

An emergency sender can be a mobile subscriber or a transferable subscriber which is transferred to a mobile subscriber. A receiver can be a fixed terminal subscriber or a transferable subscriber.

All emergency senders can send SOS and receive SOSACK. Furthermore, all mobile terminals are able to receive SOS and SOSACK addressed to All terminals group MAN.

class CSUBCOM:

If the fixed terminal has one line for speech line connection, the following MPAKs can be received and sent:

- CONREQ
- SOSCONREQ
- ADDCONREQ
- EXTCONREQ
- CONREA
- DISCON

Connection to group will be made by the MCU by converting CONORD to CONREQ.

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class DTESERV:

Following MPAKs may be sent:
 LOGINREQ
 LOGOUT
 ACTIVE
 INACTIVE
 VICESOSRX
 SOSRX *
 FLEXLIST *

* Only if the sender is a transferable subscriber.

Following MPAKs shall be received:

LOGINREQ
 LOGINGRA
 LOGINREF
 LOGOUTORD
 VICESOSRX
 SOSRX
 GROUPLIST
 FLEXREQ
 TIME

When the network layer receives masc frame N' from the masc interface, it acts in the same manner as if the MPAK never left the fixed terminal.

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9 PSEUDO CODE FOR APP_DIR

In this pseudo code all procedures start with "P_", and all functions with "F_".

```

REPEAT
    Wait for input
    CASE input signal type OF
        S_MPAK sent on radio
        IF from = "RADIO_NET" THEN
            send this signal to origin
        ELSE
            forget this signal
        END IF
        S_hook_on
        P_hook_on
        S_hook_off
        P_hook_off
        S_line_up
        P_line_up
        S_line_down
        P_line_down
        S_MPAK
        P_MPAK
        concord timer
        CONNECTION_STATUS = free
        otherwise
            forget this signal
    END CASE input signal OF
UNTIL forever

```

```

P_hook_on
IF (from = AUDIO) AND (CONNECTION_STATUS <> free)
THEN
    send this signal to RADIO_NET
    send signal S_MPAK with MPAK = DISCON to
    CONNECTION_LINE
    (MPAK.sender = CONNECTION_OTHER_PARTY
     MPAK.addressee = CONNECTION_PARTY_HERE
     MPAK.type_dependent.line_number = 0
     MPAK.type_dependent.CONN_ID=CONNECTION_CONN_ID)
    CONNECTION_STATUS = free
ELSE
    forget this signal
END IF (from = AUDIO) AND (CONNECTION_STATUS <> free)...
END P_hook_on

```

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```

P_hook_off
IF from = AUDIO THEN
  IF CONNECTION_STATUS = waiting_for_hook_off THEN
    CONNECTION_STATUS = busy
    send this signal to RADIO_NET
    reset concord_timer
  ELSE
    forget this signal
  END IF CONNECTION_STATUS = waiting_for_hook_off...
ELSE
  IF (from=RADIO_NET) AND (signal_status =
                                signal_status_not_sent) THEN
    forget this signal
    send signal S_MPAK with MPAK = DISCON to
    CONNECTION LINE
    ( MPAK.sender = CONNECTION OTHER PARTY
      MPAK.addressee = CONNECTION_PARTY_HERE
      MPAK.type_dependent_line_number =0
      MPAK.type_dependent_CONN_ID = CONNECTION_CONN_ID )
    CONNECTION_STATUS = free
  ELSE
    forget this signal
  END IF (from = RADIO_NET) AND (signal_status =...)
END IF from = AUDIO...
END P_hook_off

P_line_down
mark origin in MCU_REG as line_down
FOR all MAN in our flexlist pointing at origin DO
  send signal S_MPAK with MPAK = logout to RADIO_NET
  ( MPAK.sender = MAN in question from flexlist
    MPAK.addressee = the MOBITEX network
    MPAK.type_dependent_part = MCU_MAN )
  remove MAN in question from our flexlist
END FOR all MAN in our flexlist pointing...
END P_line_down

P_line_up
send signal S_MPAK with MPAK = grouplist to origin
( MPAK.sender = the MOBITEX network
  MPAK.addressee = MCU_MAN
  MPAK.type_dependent_Part = our grouplist )
send signal S_MPAK with MPAK = flexreq to origin
( MPAK.sender = the MOBITEX network
  MPAK.addressee = MCU_MAN )
mark origin in MCU_REG as line_up
END P_line_up

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```

P_MPAP
  IF signal_status = signal_status_ok THEN
    IF from = RADIO_NET THEN
      P_MPAP_from_radio
    ELSE
      P_MPAP_from_other
    END IF ffrom = RADIO_NET...
  ELSE
    IF origin = from THEN
      forget this signal (can't send this signal in any
      direction)
    ELSE
      IF origin = RADIO_NET THEN
        forget this signal (Never send back MPAP to
        network)
      ELSE
        IF MPAP.unknown_f = 0 THEN
          CASE MPAP.packet_class OF
            PSUBCOM,PSOSCOM
              signal_status = signal_status_ok
              signal_type = S_not_sent_MPAP
              send this signal to origin
            CSUBCOM
              CASE MPAP.packet_type OF
                CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
                  signal_status = signal_status_ok
                  signal_type = S_not_sent_MPAP
                  send this signal to origin
                  CONNECTION_STATUS = free
                otherwise
                  forget this signal
                END CASE MPAP.packet_type...
            DTESERV
              CASE MPAP.packet_type OF
                VICESOSRX,SOSRX
                  signal_status = signal_status_ok
                  signal_type = S_not_sent_MPAP
                  send this signal to origin
                LOGINREQ
                  remove MPAP.type_dependent_part from our
                  flexlist
                  signal_status = signal_status_ok
                  signal_type = S_not_sent_MPAP
                  send this signal to origin
                otherwise
                  forget this signal
                END CASE MPAP.packet_type...
            END CASE MPAP.class...
          ELSE
            forget this signal
          END IF MPAP.unknown_f.
        END IF origin...
      END IF signal_status...
    END P_MPAP
  
```

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```

P_MPAP_from_other
  mark 'origin' in MCU_REG as line_up
  CASE MPAP.packet_class OF
    PSUBCOM,PSOSCOM
      IF MPAP.unknown_f = 1 THEN
        IF (F_get_receiver_MAN in our grouplist ) OR:
        (F_get_receiver_MAN = MCU_MAN ) THEN
          forget this signal
        ELSE
          IF F_get_receiver_MAN in our flexlist THEN
            remove_F_get_receiver_MAN from our flexlist
            send signal S_MPAP with MPAP = LOGOUT to RADIO_NET
              (MPAP.sender = F_get_receiver_MAN
               MPAP.addressee = the MOBITEX network
               MPAP.type_dependent_part = MCU_MAN )
          END IF F_get_receiver_MAN in our flexlist
          send this signal to RADIO_NET
        END IF (F_get_receiver_MAN in our grouplist...
        ELSE ( IF MPAP.unknown_f = 1 ... )
          IF (MPAP.state <> OK ) OR ( MPAP.digital_f =1 ) THEN
            signal_type = S_returned_incorrect_MPAP
            send this signal to origin
          ELSE
            IF (F_get_transmitting_MAN = MCU_MAN ) or
              (F_get_transmitting_man in our flexlist with status
               ok_login ) THEN
              send this signal to RADIO_NET
            ELSE
              send signal S_MPAP with MPAP = LOGOUTORD to origin
              (MPAP.sender = the MOBITEX network
               MPAP.addressee = MCU MAN
               MPAP.type_dependent_part= F_get_transmitting_MAN)
              signal_type = S_not_sent_MPAP
              signal_status = signal_status_ok
              send this signal to origin
            END IF (F_get_transmitting_MAN = MCU_MAN...
          END IF MPAP.state...
        END IF MPAP.unknown_f...
      CSUBCOM
      CASE MPAP.packet_type OF
        CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
          IF ( MPAP.unknown_f = 0 ) and
            ( MPAP.mailbox_f = 0 ) and
            ( MPAP.sendlist_f = 0 ) and
            ( mpap.state = OK ) THEN
              IF (F_get_transmitting_MAN = MCU_MAN ) or
                (F_get_transmitting_MAN is in our flexlist with
                 status ok_login )
              THEN
                IF CONNECTION_STATUS = free THEN
                  CONNECTION_line = origin
                  CONNECTION_status = busy
                  send this signal to RADIO_NET

```

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```

ELSE
    signal_type = S_not_sent_MPAK
    signal_status = signal_status_ok
    send this signal to origin
END IF CONNECTION_STATUS = free...
ELSE
    send signal S_MPAK with MPAK = LOGOUTORD to
    origin
    ( MPAK.sender = the MOBITEX network
    MPAK.addressee = MCU_MAN
    MPAK.type_dependent_part =
    F_get_transmitting_MAN )
    signal_type = S_not_sent_MPAK
    signal_status = signal_status_ok
    send this signal to origin
END IF (F_get_transmitting_MAN = MCU_MAN...
ELSE
    signal_type = S_returned_incorrect_MPAK
    send this signal to origin
END IF (MPAK.unknown_f = 0...
CONREA
IF ( CONNECTION_STATUS = waiting_for_hook_off ) and
( origin = CONNECTION.line ) THEN
    forget this signal
    send signal S hook off to RADIO_NET
    CONNECTION_STATUS = busy
    reset conord_timer
ELSE
    forget this signal
DISCON
IF ( CONNECTION_STATUS <> free) and
( origin = CONNECTION.line ) THEN
    forget this signal
    send signal hook on to RADIO_NET
    CONNECTION_STATUS = free
ELSE
    forget this signal
otherwise
    forget this signal
END CASE MPAK.packet_type...
DTESERV
CASE MPAK.packet_type OF
LOGINREQ,LOGOUT,ACTIVE,INACTIVE,VICESOSRX,SOSRX,FLEXLIST
IF (MPAK.state = ok) AND
( MPACK.digital_f = 0 ) AND
( MPACK.mailbox_f = 0 ) AND
( MPACK.sendlist_f = 0 ) AND
( MPACK.unknown_f = 0 ) AND
( MPACK.extern_f = 0 ) AND
( MPACK.addressee = MOBITEX network ) THEN
CASE MPAK.packet_type OF
LOGINREQ,ACTIVE,INACTIVE,FLEXLIST
    IF MPAK.sender = MCU_MAN THEN
        CASE MPAK.packet_type OF

```

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```

LOGINREQ
  IF MPAK.type_dependent_part in our flexlist
  with status = ok login THEN
    send signal S_MPAK with MPAK LOGINGRA to
    origin
    ( MPAK.sender = the MOBITEX network
      MPAK.addressee = MCU_MAN
      MPAK.type_dependent_part =
        =<old:MPAK.type_dependent_part )
    forget this signal
  ELSE
    IF more space exists in our flexlist THEN
      mark MPAK.type_dependent_part in our
      flexlist
      with status under_login and line =
      origin
      send this signal to RADIO_NET
    ELSE
      signal_type = S_not_sent_MPAK
      signal_status = signal_status_ok
      send this signal to origin
    END IF more space in our flexlist...
  END IF MPAK.type_dependent_part in our...
ACTIVE,INACTIVE
  IF origin may deactivate THEN
    P line down
    send this signal to RADIO_NET
  ELSE
    P line down
    forget this signal
  END IF origin may activate/inactivate...
FLEXLIST
  FOR all MAN in MPAK.FLEXLIST not in our
  flexlist
    with status ok login DO
      send signal S_MPAK with MPAK = logoutord
      to origin
      ( MPAK.sender = the MOBITEX network
        MPAK.addressee = MCU_MAN
        MPAK.type_dependent_part = MAN in
          question )
    END FOR all MAN in MPAK.FLEXLIST not in our...
    forget this signal
  END CASE MPAK.packet_type
  ELSE ( IF MPAK.sender = MCU_MAN)
    signal_type = S_returned_incorrect_MPAK
    send this signal to origin
  END IF MPAK.sender = MCU_MAN...

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```

VICESOSRX,SOSRX
  IF MPAK.sender in our flexlist with status
    ok_login THEN
      send this signal to RADIO_NET
    ELSE
      signal_type = S_not_sent_MPAK
      signal_status = signal_status_ok
      send this signal to origin from
    END IF MPAK.sender in our flexlist with status...
  LOGOUT
  IF MPAK.sender in our flexlist with any status
  THEN
    delete MPAK.sender from our flexlist
    MPAK.type_dependent_part = MCU_MAN
    send this signal to RADIO_NET
  ELSE
    forget this signal
  END IF MPAK.sender in our flexlist ...
END CASE MPAK.packet_type...
ELSE
  signal_type = S_returned_incorrect_MPAK
  send this signal to origin
END IF (MPAK.state = ok...
otherwise
  signal_type = S_returned_incorrect_MPAK
  send this signal to origin
END CASE MPAK.packet_type...
END CASE MPAK.class...
END P_MPAK_from_other

P_MPAK_from_radio
CASE MPAK.class OF
PSUBCOM,PSOSCOM
  IF F_get_receiver MAN in our flexlist THEN
    send this signal to line in question
  ELSE
    IF ( F_get_receiver MAN = MCU_MAN ) OR
    ( F_get_receiver MAN in our grouplist ) THEN
      CASE MPAK.class OF
        PSUBCOM
          CASE MPAK.packet_type OF
            TEXT
              P_copy_and_send_signal( text )
            STATUS
              P_copy_and_send_signal( status )
            HDATA
              P_copy_and_send_signal( hdata )
            DATA
              P_copy_and_send_signal( data )
            EXTPAK
              P_copy_and_send_signal( EXTPAK )
        otherwise
          forget this signal
      END CASE MPAK.packet_type...
    END IF
  END IF
END CASE MPAK.class...
```

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1/1056	A 296 5175	Ue
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```

PSOSCOM
  IF ( MPAK.packet_type = SOS or SOSINFO )
  AND ( MPAK.addressee = all terminal group MAN )
  THEN
    IF MPAK.sender in out flexlist THEN
      send this signal to line in question
    ELSE
      P_copy_and_send_signal( emergency )
    END IF MPAK.sender in our flexlist...
  ELSE
    P_copy_and_send_signal( emergency )
  END IF ( MPAK.packet_type = SOS or SOSINFO..
  END CASE MPAK.class...
ELSE
  ( This case can not appear; the network layer shall
  take care of unknown MPAKs from the network)
  MPAK.unknown_f = 1
  send this signal to RADIO_NET
END IF ( F_get_receiver_MAN = MCU_MAN...
END IF F_get_receiver_MAN in our flexlist...
CSUBCOM
CASE MPAK.packet_type OF
  CONREQ,ADDCONREQ,SOSCONREQ,EXTCONREQ
  IF MPAK.state <> ok THEN
    P_discon
  ELSE
    IF F_get_receiver_MAN in our flexlist THEN
      CONNECTION_STATUS = waiting_for_hook_off
      CONNECTION_LINE = line in question from flexlist
      CONNECTION_PARTY_HERE = MPAK.addressee
      CONNECTION_OTHER_PARTY = MPAK.sender
      CONNECTION_CONN_ID = MPAK.type_dependent.conn_id
      send this signal to line in question
    ELSE
      IF F_get_receiver_MAN = MCU_MAN THEN
        CONNECTION_STATUS = waiting_for_hook_off
        CONNECTION_PARTY_HERE = MPAK.addressee
        CONNECTION_OTHER_PARTY = MPAK.sender
        CONNECTION_CONN_ID = MPAK.type_dependent.conn_id
        send this signal to first line in MCU_REG with
        (line_status = up) AND (msg_type = speech)
        IF no such line THEN
          forget this signal
          CONNECTION_STATUS = waiting_for_hook_off
          send signal S_hook_on to RADIO_NET
        ELSE
          CONNECTION_LINE = line in question from
          MCU_REG
        END
      ELSE
        forget this signal
        send signal S_hook_on to RADIO_NET
      END IF ( F_get_Feceiver_MAN = MCU_MAN...
      END IF F_GET_receiver_MAN in our flexlist...
    END IF MPAK.state <> ok
  END

```

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Response

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```

CONORD
  IF CONNECTION_STATUS = free THEN
    IF F_get_receiver_MAN in our grouplist THEN
      MPAK.packet_type = CONREQ
      CONNECTION_STATUS = waiting for hook_off
      CONNECTION_PARTY_HERE = MPAK.addressee
      CONNECTION_OTHER_PARTY = MPAK.sender
      CONNECTION_CONN_ID= MPAK.type_dependent.conn_id
      send this signal to first line in MCU_REG with
      ( line_status = up ) AND ( msg_type = speech )
      IF no such line THEN
        forget this signal
        CONNECTION_STATUS = free
        send signal S_hook_on to RADIO_NET
      ELSE
        CONNECTION_LINE = line in question from MCU_REG
        set timer: conord_timer
      END
    ELSE
      forget this signal
      send signal S_hook_on to RADIO_NET
      END IF F_get_receiver_MAN in our grouplist...
    ELSE
      forget this signal
    END IF CONNECTION_STATUS = free...
DISCON
  P_discon
  otherwise
  forget this signal
END CASE MPAK.packet_type...
DTESERV
CASE MPAK.packet_type OF
  LOGINREQ,LOGINREF,LOGOUTORD
    IF MPAK.type_dependent in our flexlist THEN
      send this signal to line IN QUESTION
      remove MAN in question from our flexlist
    ELSE
      forget this signal
    END IF MPAK.type_dependent in our flexlist THEN
  LOGINRA
    IF MPAK.type_dependent in our flexlist THEN
      mark in our flexlist status = ok_login
      send this signal to line in question
    ELSE
      send signal S_MPAK with MPAK = logout to RADIO_NET
      ( MPAK.sender = MCU MAN
      MPAK.addressee = MÖBITEX network
      MPAK.type_dependent_part = MAN in question
    END IF MPAK.type_dependent in our flexlist ....

```

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1990-02-23 B
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FLEXLIST
FOR all MAN in this signal who are not in our flexlist
    send signal S_MPAK with MPAK = logout to RADIO_NET
        ( MPAK.sender = MCU_MAN
          MPAK.addressee = MOBITEX network
          MPAK.type_dependent_part = MAN in question)
END
FOR all MAN in our flexlist who are not in this signal
    send signal S_MPAK with MPAR = logoutord to line in
    question
        ( MPAK.sender = MOBITEX network
          MPAK.addressee = MCU_MAN
          MPAK.type_dependent_part = MAN in question )
    remove MAN in question from our flexlist
END
TIME
send a copy of this signal to all lines
GROUPLIST
store grouplist from this signal in our register
send a copy of this signal to all lines
SOSRX,VICESOSRX
IF F_get_receiver MAN in our flexlist THEN
    send this signal to line in question
ELSE forget this signal
END CASE MPAK.packet_type OF...
END P_MPAK_from_radio

```

```

P_copy_and_send_signal( type )
    send a copy to all lines in MCU REG with
    ( line_status = up ) and ( msg_type = type )
END P_copy_and_send_signal

```

```

P_discon
IF CONNECTION_STATUS <> free
    send this signal to CONNECTION_LINE
    CONNECTION_STATUS = free
ELSE
    forget this signal
END
END P_discon

```

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```
F_get_receiver_MAN
CASE MPAK.state OF
    ok,from_mail
        F_get_receiver_MAN = MPAK.sender
    otherwise
        F_get_receiver_MAN = MPAK.addressee
    END CASE
END F_get_receiver_MAN

F_get_transmitting_MAN
IF MPAK.unknown F = 0 THEN
    F_get_transmitting_MAN = MPAK.sender
ELSE
    F_get_transmitting_MAN = F_get_receiver_MAN
END
END F_get_transmitting_MAN
```

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No.	1/1056 - A 296 5175 Ue
Date	1990-02-23 B MTS198.1

10 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

This document includes a number of references, made to other sections in the terminal specification. The list below shows these references, together with the page(s) they are made on. Please note that a section could be referred to several times on the same page.

- R1-09, 3
- R1-16, 3

Below are the reference designations listed.

<u>Reference</u>	<u>Section</u>
R1-01	Arrangement of the documents
R1-02	MOBITEX System description
R1-03	General description of terminals
R1-04	Terminology
R1-05	References
R1-06	Network operator information
R1-08	Application layer
R1-09	Network layer
R1-11	Interface requirements, fixed terminals
R1-12	Other requirements, fixed terminals
R1-16	Link layer, mobile terminals
R1-17	Physical layer, mobile terminals
R1-18	Radio equipment, mobile terminals
R1-19	Other interfaces, mobile terminals
R1-20	Other requirements, mobile terminals

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B-10 Sheet
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REQUIREMENT SPECIFICATION

Document Prepared ET/SYS PES	Document Review Approved ET/SYS PES	Document No. 1056 - A 296 5177/02 Ue
Document Controlled: Document Approved ET/SYSC STT STT		Document Date 1990-02-26 A Rev. F.1 Pl. MTS20.2
Description Cantel Mobitex General requirements, mobile term.		

SUMMARY

The general requirements for MOBITEX mobile terminals are described in this document. These include environmental requirements, power supply requirements, the minimum requirements for controls and indicators and special requirements in connection with the type approval testing.

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Report

A 2965177/02

Cantel Mobitex™

Nr.	A 296 5177/02 Ue
Date	1990-02-26
F.A.	MTS20.2

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Subject

Report

A 296 5177

Cantel Mobitex

1056 - A 296 5177/02 Ue
 Datum: 1990-02-26 Signatur: MTS20.2

1 ENVIRONMENTAL REQUIREMENTS

The equipment must be operational also under the extreme temperature conditions. No error functions which can interfere with the operation of the MOBITEX network must occur under any environmental condition.

1.1 Temperature

The normal operational temperature range:

+15 to +35 degrees C.

The extreme operational temperature range:

-25 to +55 degrees C.

The equipment should be such that it is not damaged by storage in the temperature range of:

-40 to +70 degrees C.

1.2 Relative humidity

Mobil terminal should be able to withstand 20-75% RH.

1.3 Vibrations

The equipment should be able to withstand a vibration test in accordance with IEC publication 68-2-6:

10 - 55 Hz +/- 0,15 mm movement.

55 - 150 Hz 20 m/s square acceleration.

Sweep rate: 1 octave per minute

Duration: 2 hours in each of the three directions.

The equipment should not be in operation during the test but should comply with the requirements in the MOBITEX terminal specification after the test.

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2 POWER SUPPLY

2.1 Nominal voltage

The nominal voltage is optional and should be stated by the manufacturer.

2.2 Voltage limits

Equipment designed for working from lead acid accumulators in a vehicle should comply with the specifications when the voltage varies from 0.9 to 1.3 times the nominal voltage.

Equipment designed for operating on an alternating voltage should comply with the specifications when the voltage varies by +10%.

If these limiting values are exceeded, error functions which can interfere with the operation of the network should not occur.

3 MARKING

The equipment should be clearly marked with the manufacturer, type designation, serial number, approving text ("Approved by ...") and registration number of the type approval. The marking should be engraved on metal and permanently fixed to the equipment.

The mobile terminal's subscription number should be clearly visible or accessible.

3.1 Electronic serial number check

The serial number should be stored together with the terminal subscription MAN and permanently in such a way that they are impossible to change by software or by unauthorised persons, preferably in encrypted form.

The serial number of the equipment should be checked in the terminal against the serial number stored together with the MAN at power on. If the numbers are not equal, it should be impossible to use the equipment.

In addition, the serial number (ESN) is sent to the network at "activation", to be checked with the serial number stored in the network (see reference R1-09).

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4 CONTROLS

There are no requirements for type approval of controls.
There are certain recommendations however.

If number keys for number keying are used, they should comply with one of the following minimum configurations.

1	2	3	4	5	*	A	B
6	7	8	9	0	#	C	D

1	2	3	A
3	4	5	B
5	6	7	C
7	8	*	D
9	0	#	
*	#		
A	B		
C	D		

The following recommendations apply for the A, B, C and D keys. The D key should have the data send function. If there is a speech facility, key C is used for "speech request". The key should be marked with T. Keys A and B can be used for status or another function and marked according to use.

International standards should be followed if a completely alphanumeric keyboard is used. The number keys on the keyboard can then be used for number keying as well.

5 INDICATORS

An indicator with yellow or amber colour should indicate when the power is switched on.

An indicator with green colour should indicate with a steady light when the mobile terminal is in contact with the MOBITEX network and with a twinkling light when it is not (base search mode).

Signal

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6 TYPE APPROVAL TESTING

Except the equipment described in the chapters below, requirements may be specified by the network operator (please refer to reference RI-06) for equipment such as:

- Portable antennas
- Cabling and terminations
- Terminal display

6.1 Equipment to be type approved

The type approval test applies to the radio equipment and to the physical, link and network layers of the mobile equipment according to these specifications. Application layer functions are only tested if under special requirements when installed.

The type approval only applies to the software tested. If a change is made in any software stored in the same storage unit as the software handling the tested functions, a new type test must be made. The testing authority should determine at its discretion and based on documentation of the modifications, whether new measurements are necessary for a new approval.

Optional terminal equipment to be connected to the radio control unit is not type tested.

6.2 Normal test conditions

The mobile terminal should be tested in the normal environment stated above. The specified data should be compiled with for all combinations.

Terminals designed for operating on lead acid accumulators in vehicles should be tested at 1.0 times the nominal voltage.

The terminal should be ready for operation within 1 minute of switching on the power.

6.3 Extreme test conditions

Additional environmental requirements can be made in reference RI-06 (Network operator information).

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The mobile unit should be tested at the lower and upper limits in the temperature and voltage ranges stated above.

Before testing is carried out, the equipment should have achieved thermal equilibrium in the test chamber. The power supply should be switched off during this period. Measurements should be carried out in such a sequence and with relative humidity controlled so that excessive condensation does not occur.

Testing at the upper temperature limit should begin with the sender in the send position for 1 minute and receiving for 4 minutes after which measurements are carried out.

Testing at the lower temperature limit should commence 1 minute after switching on the power supply.

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6.4 Test connections, interfaces and controls

For the type approval test, the mobile terminal should be equipped with test connections and manual controls to permit the measurements that are necessary to verify that the specification requirements are complied with. This applies particularly to the requirements stated in reference RI-18 ("Radio equipment, mobile terminals" and "Measurement methods"). These connections and controls can be implemented by external test adaptors during the test.

For the type approval test, the equipment should also be equipped with the "Machine interface (MASC)" as described in reference RI-19 ("Other interfaces, mobile terminal", minimum basic and type test functions). This interface can be implemented by an external test adaptor during the test.

Equipment intended to be used as partially active in MOBITEX should be possible to operate as a normal mobile terminal during the tests, i.e. continuously listening to MOBITEX.

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7 MOBITEX TERMINAL SPECIFICATION REFERENCE LIST

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RL-06, 6
 RL-09, 4
 RL-18, 8
 RL-19, 8

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